

SCIENCE.

FRIDAY, JULY 18, 1884.

COMMENT AND CRITICISM.

IN a previous number of *Science* we have alluded to several items of scientific interest in the sundry civil bill. All these items, except that relating to the naval observatory, have passed in a satisfactory form. The electrical commission, which is to prosecute its labors during the Franklin institute exhibition next autumn, is to be appointed by the president. No special number of commissioners is prescribed, so that the composition of the commission is entirely in the hands of the authorities. The most difficult question connected with the make-up of the commission will be that of admitting into its ranks those who are interested in the various electric-light companies, or who are employees of such companies. There is no doubt whatever, that, if any such interested parties are appointed on the commission, care should be taken that the leading companies be equally and fairly represented. That this could be done in a satisfactory manner does not seem at all likely; and we must therefore look forward to a disinterested commission, before which all parties interested shall have a fair hearing. The amount appropriated for expenses is seventy-five hundred dollars.

An appropriation of five thousand dollars has been made for the expenses of the meridian conference called by our government. Provision has been made for two additional conferees on the part of our government, thus conforming to the views expressed in a recent number of *Science*. That course seems to have been suggested independently by the government, and was, no doubt, prompted by the evident desirability of having astronomical science well represented in our discussion of the question.

The question of the organization of the signal-service, coast and geodetic survey, geologi-

cal survey, and hydrographic office, is to be considered by a congressional commission of three senators and three representatives. The senators are Messrs. Allison, Hale, and Pendleton; the representatives, Messrs. Lowry of Indiana, Herbert of Alabama, and Lyman of Massachusetts. The selection of Mr. Lyman is understood to be due to his membership of the National academy, which designed the organization of the geological survey five years ago.

The proposition authorizing the appointment of a scientific commission to inquire into the organization of the naval observatory, under direction of the secretary of the navy, was rejected by the senate after passing the house. The significance of the rejection hardly needs to be commented upon, further than to remark, that it is well understood to be due to naval influence, and may be taken as an index of the willingness of naval officers to have their management inquired into.

Two academic honors have recently been conferred in this country upon scientific men, which are worthy of note because more rare and costly than such distinctions usually are. At New Haven, on the day before commencement, a bronze statue of Professor Silliman, for more than fifty years a teacher of chemistry, mineralogy, and geology in Yale college, and the founder of the *American journal of science and arts*, was placed on its pedestal near the new chapel. The artist is Prof. John F. Weir of the Yale art school. He had not the advantage of knowing Professor Silliman, but from numerous existing portraits, and from a study of the personality of his subject, he has succeeded in reproducing and perpetuating, in a very satisfactory manner, the aspect, the bearing, and the character of one of the pioneers in American scientific education. The figure is standing, is larger than life, and is in the costume of the day.

skilfully draped with a cloak. In the right hand a crystal is held, the only symbolism which the artist has employed. The inscription is restricted to the name, the title, and the dates; and it might well be supplemented, on the other side of the pedestal, with some descriptive phrase or with an appropriate motto. Without such accessories, the monument barely suggests the affectionate regard in which Professor Silliman was held by those who graduated at Yale during the first half of this century. The regret has also been expressed, that the statue was not placed in or near the Peabody museum of mineralogy and geology, where everybody would be reminded, that, when Silliman began his work, the collections of Yale college (now so magnificent) were packed in a candle-box, and carried to Philadelphia for identification. The man and his influence would thus be inevitably associated. If these two changes could be made in the inscription and the position, this well-deserved and well-executed memorial would be still more satisfactory than it is to those who honor the teacher whom it represents.

The other honor to which we refer is that of a medal struck at the U.S. mint in Philadelphia, at the request of the colleagues and friends of Professor Sylvester, to commemorate his residence in Baltimore during a period of seven years, marked, among other things, by the establishment of the *American journal of mathematics*. The medal, in size and general aspect, is not unlike that which was struck in commemoration of the life of Agassiz. On one side is an accurate and spirited portrait of the mathematician, with the name Sylvester: on the reverse a Latin inscription commemorates the fact that he was for seven years professor of mathematics in the Johns Hopkins university, — from 1876 to 1883. The original medal in gold was sent to Professor Sylvester, in his new home in the University of Oxford; a duplicate in silver was retained in Baltimore; and a few impressions in bronze have been distributed among his scientific friends and correspondents.

ATTENTION is called elsewhere in our columns to the laborious researches and brilliant discoveries by Koch before he was sent by the German government to Egypt and India to study cholera. Work of value upon the subject of micro-organisms is not done in this country, nor will it be until some such encouragement is offered to investigators, as is the case in France and Germany. This kind of research requires the rare combination of many forms of training, added to a critical, analytical, and judicial mind. These we can have; but until the facilities for the work are offered, until the necessity for personal sacrifice and self-denial is done away with, we can hope for no better work in the future than has been done in the past: in other words, what is first needed in order to place our own investigations upon an equality with those of the two countries mentioned above, is a thoroughly equipped, fully endowed laboratory, with a strong corps of well-trained and salaried officials.

The congressional bill, offering a reward of one hundred thousand dollars to the discoverer of the cause of yellow-fever, will meet with no claimants worthy of the name from workers in this country. It may, and probably will, attract a crowd of mycologists; but the hope that any thing of permanent value will come from it is an exceedingly faint one. The investigation can only be made through the outlay of private capital, which will be slow to seek any such channel for investment. The first expense would be great, and the total disbursements necessary for any complete experimental evidence upon the subject would be beyond the calculations of any but those familiar with such work. The true way to encourage such an inquiry lies in the establishment of a commission composed of men thoroughly trained and qualified for the work, and then to treat it as the German government has treated its cholera commission; that is, to give it full powers and funds to allow the prosecution of its labors to the end.

So far as Koch's work upon tuberculosis is

concerned, it remains a complete monument of scientific accuracy, and has suffered nothing in the time since it was erected. The strength of his arguments has not been in the least weakened, the accuracy of his experiments stands unassailed, and the justness of his conclusions is thus far incontrovertible. As matters stand to-day, we are bound to consider that the cause of tuberculosis is found, and that that cause is, or is contained in, the bacillus of Koch, to whom all honor is due for the beauty and completeness of his investigations upon this important subject.

In our account of the last annual meeting of the National academy of sciences, reference was made to the gift of eight thousand dollars by the widow of the late Dr. J. Lawrence Smith, a member of the academy. The deed of trust has recently been executed, and provides that the interest of the fund shall be used in striking a gold medal of the value of two hundred dollars, to be called the 'Lawrence Smith medal,' and to be awarded by the academy, not oftener than once in two years, "to any person in the United States of America, or elsewhere, who shall make an original investigation of meteoric bodies, the results of which shall be made known to the public; such result being, in the opinion of the National academy of sciences, of sufficient importance and benefit to science to merit such recognition." The investigation for which the award is made, or its completed publication, must "have been made since the time of the last preceding award." Preference is given to a citizen of the United States, when the choice may lie between such a one and a foreigner. Any sums which may accumulate from the interest of the fund, above what is required for the purposes specified, is to be used "in aid of investigation of meteoric bodies, to be made and carried on by a citizen or citizens of the United States of America."

We recall but three other important honorary awards at the disposal of learned societies in this country, — the Magellanic, the Rumford,

and the Walker, to mention them in the order of their foundation. The Magellanic, founded by John Hyacinth de Magellan, is an "oval plate of solid gold, of the value of ten guineas," which may be annually bestowed by the American philosophical society "to the author of the best discovery or most useful invention relating to navigation, astronomy, or natural philosophy (mere natural history only excepted);" but the discovery must be unpublished, and never before publicly rewarded. We are not aware that it has ever been bestowed. The Rumford, founded by Count Rumford, is a gold and silver medal, bestowed biennially by the American academy of arts and sciences for notable researches by an American in light or heat. The Walker, founded by the late Dr. William J. Walker of Boston, is a money-prize of from five hundred to a thousand dollars, given once in five years by the Boston society of natural history to an American for specially valuable investigations in some department of natural history. The addition to this meagre list is therefore most welcome. Through the excellent provision granting the power of using any surplus in the direction of research, the necessity of awarding the prize to claimants of insufficient merit is avoided, and the branch of investigation to which it applies is thereby doubly fostered: but we wish the requirement that the investigation which is crowned must have been made since the previous award, could be modified to a definite term of years; since, if two important investigations claimed the award, one would now be forever debarred.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The use and spelling of terms, and some facts in embryology.

IN *Science*, No. 73, a critic notices my recently published 'Contribution to the embryography of osseous fishes.' I reply as follows: Fault is found with my terms 'embryography,' 'yelk,' etc. I chose the word 'embryography,' not from a mere pedantic or eccentric whim, but because it was an expressive term, and covered what I meant in the general discussion, or *description*, of the development of a considerable

number of species. The word 'yolk' is spelled according to the most approved usage throughout my memoir, both Webster and Worcester agreeing in this; and I would commend to my critic's attention the remarks relating to this word to be found in the work of the latter authority, where both Johnson and Walker are also cited in favor of the same spelling.

The expression of opinion by my critic as to the relative value of previous literature is unfortunate. Hoffmann's paper on the teleostean egg was cited for the very good reason that it was undoubtedly the most thorough and consecutive upon its special subject, which had appeared up to that time, or even to the present. No American work can yet claim such a distinction.

The charge that I have 'padded' my paper with unnecessary quoted matter is unfair; for, out of one hundred and eighteen pages of text, nine are taken up with citations,—a proportion greatly exceeded in the papers of many competent authorities. And I ask my critic, in all fairness to me, if, by throwing out any one of the quoted passages, the paper as a whole would not lose in thoroughness and clearness of statement; for the object of my paper was to give a general statement of the facts relating to the development of fishes, so that it might be safely referred to, especially as to the early stages.

Whether my critic sees fit to accept my views upon the layer which I have termed the 'yolk-hypoblast,' is a matter of indifference to me. For his benefit, I may cite the names of the following masters in embryology, who agree with me more or less closely: Vogt, Kupffer, Hoffmann, Rauber, Gensch, Ziegler, and even, in one sense, His and Kölliker.

JOHN A. RYDER.

Smithsonian Institution, Washington, D.C.,
June 30.

[Mr. Ryder will not find 'yolk' used by the leading embryologists, either in England or America; 'yolk' being the form used by Huxley, Balfour, Allen Thompson, Agassiz, etc. 'Embryology' is also similarly employed, instead of 'embryography.' In our notice, it was not said that either word was incorrect; but we meant exactly what was printed, that they are a 'little eccentric.' In regard to Hoffmann's paper, it is by no means 'the most thorough,' but contains important errors. We fail to see how the value of Hoffmann's paper is affected by American work being considered less good. We regard Mr. Ryder's own essay as much more valuable than Hoffmann's. As to the padding, we think the charge fair that the essay contains 'an unnecessary number of lengthy extracts and abstracts:' the latter Mr. Ryder ignores. It is generally understood that very little editorial supervision is exercised over most of our government publications: hence they are often diffusely written, and charged with much which might better be omitted. We do not think that Mr. Ryder intentionally put in matter to fill out; but we do think he failed to leave out much that he would have omitted if his article had been for a carefully edited scientific journal. As to the 'yolk-hypoblast,' the future will decide between our opinions.

Mr. Ryder is under a misapprehension, if he thinks our notice was intended to be unfavorable; for although we pointed out some blemishes, as we held them to be, we intended to convey the impression that the substance of the work appeared to us very meritorious: therefore we said that 'the work had been done with evident care and patience,' and mentioned a long series of observations which might be

'signalized as being of especial interest and importance.' — Ed.]

A remarkable new type of mollusks.

A very remarkable new form of Mollusca has recently been submitted to me for examination by Mr. G. W. Tryon of Philadelphia, who received it from Mr. C. R. Orcutt of San Diego, Cal. It was collected near that place on a stony bottom, where other bivalves are found in their season, and which appears to be nearly dry at low water. Other specimens were received direct from Mr. Orcutt, who collected about fifty. This animal is a pelecypod or lamellibranch with an *internal shell*. Nothing of the sort, or in the least approaching it, has ever been described.

The animal, from the collector's drawings, is, when living, somewhat of the shape of a small globose Cypraea, of inflated ovoid form, translucent, jelly-like, dotted above with small, rounded papillae, which appear of an opaque white on the general translucent ground. When living, Mr. Orcutt states, it was over an inch in length. The specimens sent have been contracted by alcohol to less than half an inch in length. The mantle which covers the dome of the body is tough and thick: the sides are smooth, and nearly free from papillae. The superior median line is a little depressed. The basal part of the anterior end in life is prolonged beyond the general mass in a wide trough, with the convexity upward, and somewhat expanded at its anterior extremity. About one-third of the way from the anterior end, the mantle is perforated by an orifice, which pierces it in the vicinity of the mouth. The edges of this orifice project from the general surface, and it is lined with close-set, small papillae. At about the same distance from the posterior end is another tubular perforation, holding a similar relation to the anus; which has, however, plain edges, and is not internally papillose.

Turning the animal over, we find the anterior trough of the mantle prolonged backward, like a slit with plain edges, to about the posterior third; from this projects a narrow, hatchet-shaped foot, with a strongly marked byssus-gland at its posterior angle; from this a bunch of white byssus extends to the stone or other object to which this mollusk attaches itself. The cavity of the mantle extends some distance behind the commissure of the pedal opening. The anterior point of the foot is roofed by the trough-like expansion above mentioned. The mouth is provided with two pairs of small palpi. Two gills, very finely microscopically laminate, extend backward from near the mouth, on each side, to the posterior end of the body, the wider one being the inner: between their posterior ends a thin reticularly perforate veil connects the two pairs, and shuts off the anal area from the rest of the mantle cavity. The intestine contains a hyaline stylet, and is considerably convoluted; but the viscera offer no marked peculiarities when compared with ordinary pelecypods. The shells are enclosed in two little sacs in the substance of the mantle. The umbones are near together, apparently connected by a brown gristle resembling an abortive ligament, and are nearly over the heart. The valves are about ten millimetres long and one millimetre wide, destitute of epidermis, prismatic, or pearly layers. There are no muscular or pallial impressions, no adductors, hinge, or teeth. They resemble in form the exterior of Gervillia, as figured by Woodward, and are pure white. As they lie in the body, they diverge at a rather wide angle from the beaks, forward. The embryonic valves are retained like two tiny bubbles on the umbones.

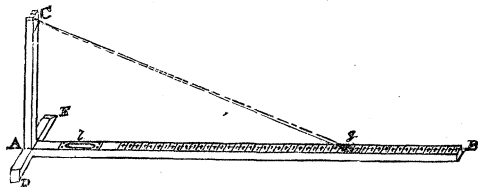
Under as recent a classification as that adopted by Lankester, in the new edition of the Encyclopaedia Britannica, this creature would form a new order, Amyaria, as opposed to the old Mono- and Dimy-aria. These orders being pretty generally given up, though not yet out of the text-books, it is probable that no others can yet be formulated. Whatever be its relations to the higher groups, a point to be determined by further study, there can be no doubt that the animal forms the type of a new family, Chlamydoconchae, and may take the name of Chlamydoconcha Orcutti. It is evident already, that the genus does nothing toward bridging the gap between the gastropods and pelecypods, but is simply a remarkably aberrant form of the latter group, and probably derived from some form with an external shell. It is able, according to Mr. Orcutt, by sphincter-like contractions of the mantle, to produce currents of water over the gills, which are probably finally ejected by the anal tube.

A paper on the subject, with figures, will be published shortly.

WM. H. DALL.

Time without instruments.

Students usually feel little interest in the method of time in astronomy by 'a single altitude of the sun,' because they do not expect to own an instrument with which to measure the altitude. They can easily make the apparatus described below, by which, with careful handling, time may be found with a probable error of fifteen seconds.



Frame together the three pieces *AB*, *AC*, and *DE*, at right angles, — *AB* about sixty inches, *AC* eighteen inches and a half, and *DE* ten inches long, and each an inch and a quarter square. Cut a half-inch slit, one inch deep, in the end *C*, and in the direction *AB*. Fasten a piece of tin one inch square, with a hole an eighth of an inch in diameter, on the right-hand face of *AC* at *C*, with its hole opposite the centre of the slit. Set in a bubble at *l* by which to level *AB*. Let fall a perpendicular from the hole in the tin plate to *AB*; and at about twelve inches from the foot of that perpendicular commence the graduation on the centre line *AB*, dividing into inches and half-inches, and numbering 12, 13, etc., towards *B*. It will be well to paste a strip of drawing-paper on the face *AB*, on which to make the graduation.

Measure once for all the exact height in inches of the centre of the hole in the tin plate above the upper face of *AB*, which should be about eighteen inches, and multiply it by the decimal .9994358, which product designate by *h*. By using this for the height of *AC*, all altitudes will be corrected for mean refraction.

To use it, place in the sunlight, — best when the sun is not less than 46° nor more than 45° high, — with *AB* levelled by the bubble, estimating by eye when *AC* is perpendicular, so that the bright spot from the hole in the tin shall fall on the graduated centre line of *AB*. With watch in hand, read the hour,

minute, and second when the centre of the elliptical bright spot is exactly on some dividing-line of the scale, and call the scale-reading *r*: then the sine of

$$\text{the sun's altitude} = \frac{h}{\sqrt{r^2 + h^2}} = \sin \alpha.$$

For the hour-angle = *P*, the most convenient formula is, — letting δ = sun's declination, and *l* = the latitude of the place, — $\cos P = \frac{\sin \alpha - \sin \delta \sin l}{\cos \delta \cos l}$.

This formula, with the known latitude (say, $36^\circ 12' 45''$), may be put in the form

$$\log \cos P = \log \{ \sin \alpha - [9.77143] \sin \delta \} + a. c. \log \cos \delta + 0.09322.$$

A nautical almanac is needed for declination and the equation of time, though tabulated mean values of these for every tenth day of the year will answer for the usual accuracy required in common local time.

The form of apparatus may be varied to suit the taste of the student, or he may use the tin disk with a plumb-line suspended from it, in connection with a straight-edge levelled by a carpenter's level, and these of any lengths he chooses.

Time by 'equal altitudes of the sun' may be found by the same device.

A. H. BUCHANAN.

Cumberland university, Lebanon, Tenn.,
July 4.

Rotation experiments on germinating plants.

The opposite growth of the root and stem of a germinating plantlet, under other influences than that of gravity, we have recently shown by the following experiments. A circular trough (seen in section, *b b*, fig. 1) some sixteen inches in diameter and three

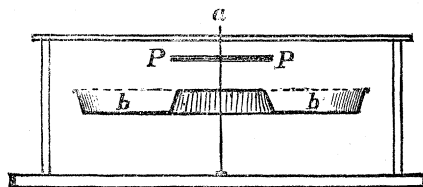
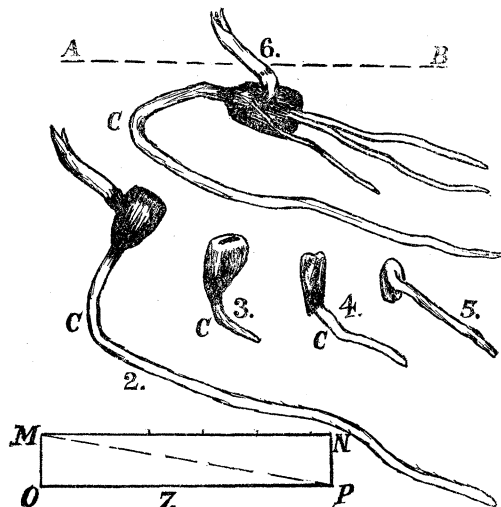


FIG. 1.

deep, rotates about the vertical axis *a a*. The trough, closely filled with earth, was planted with a quantity of well-soaked beans and seed-corn, and the whole covered with the fine gauze represented by the dotted lines. Forty-eight hours were allowed for the seeds to begin their growth, before the trough was started in rotation. By means of a Tuerk's motor, a uniform and continuous motion, at the rate of one hundred and eighty revolutions per minute, was then maintained for four days. At the end of this time the earth was carefully removed, and the positions of the young plants precisely noted. It was universally observed that the stems were accurately directed towards the axis, and the roots towards the circumference, of the trough. Figs. 2-6 represent several specimens. *A B* is the horizontal, *A* being towards axis, and *B* towards circumference; those of figs. 2, 5, and 6, were at a radius of six inches from axis; figs. 3 and 4 had radii of five and four inches. The curves at the points *C, C, C, C*, are quite significant, being the points to which the radicals had extended before

rotation commenced. The direction of the stems can be well seen in figs. 6 and 2.

The cause of this mode of growth being, of course, the outward radial tendency of the plantlet in reaction upon the centripetal force acting through the



FIGS. 2-7.

soil, we may put the intensity of the new modifier equal to the centripetal acceleration, $\left(\frac{2\pi}{T}\right)^2 r$. This gives a centrifugal 'force,' so called, of 5,348 degrees, or 5.4 *g*, at a radius of six inches. If we put *MO* (fig. 7) equal to gravity, and *MN* equal to this centrifugal 'force,' then, for an ideal case, *MP* will represent the resultant direction of the growing rootlet. This is but very loosely approximate to the observed positions, as might be expected.

CHAS. S. SLICHTER.

North-western university, Evanston, Ill.,
June 27.

Perforations in wool fibre.

In my investigations in wool fibre I have found some defective hairs that were perforated in places, evidently while growing on the sheep's back. As the perforations are perfectly circular, it would indicate that they are made by some creature at present unknown. Would it not be worth the while of some of your scientific readers to examine into the matter, and discover, if possible, what the perforator may be, and whether it is likely to remain as little injurious as at present?

JOS. M. WADE.

Boston, July 7.

The evolution of petals.

In Mr. Grant Allen's interesting treatise on the 'colors of flowers,' the first chapter deals with the evolution of petals from stamens, in which the author shows that petals are but specialized stamens set apart for the purpose of attracting insects. His proofs are such that no candid reader is likely to finish the chapter, and apply its principles to the flowers he meets in his every-day walks, without being convinced of the correctness of the author's views. The gradual devel-

opment from stamen to petal can be seen in most of those cultivated flowers which exhibit a tendency to become double, as well as in those which have already become so.

But it would seem that Mr. Allen had overlooked one point in the method of evolution. Throughout the entire book the idea is given that the process of evolution begins by the *filaments* becoming flattened. Thus, on p. 11, taking the English water-lily (*Nymphaea alba*) as a typical example, the author says, —

"In the centre of the flower we find stamens of the ordinary sort, with rounded stalks or filaments, and long, yellow anthers full of pollen at the end of each; then, as we move outward, we find the filaments growing flatter and broader, and the pollen-sacs less and less perfect; next we find a few stamens which look exactly like petals, only that they have two abortive anthers stuck awkwardly to their summits; and finally we find true petals, broad and flat, and without any trace of the anthers at all. Here, in this very ancient though largely modified flower, we have stereotyped for us, as it were, the mode in which stamens were first developed into petals, under stress of insect selection."

Again, on p. 115, he says, "It has been objected by two or three authoritative critics, that the original petals need not have been yellow, because they represent the flattened filaments, *not the anthers*;" and the author goes on to show that filaments are usually of the same color as the petals.



FLOWER OF CYDONIA VULGARIS, SHOWING TRANSFORMATION OF STAMENS TO PETALS.

An examination of a number of our common flowers shows, that, in many cases at least, the evolution of the petal begins with the *anther* rather than the filament. Thus, in the common quince (*Cydonia vulgaris*), many of the flowers possess stamens of which the anthers have become petaloid, while the filaments are of the normal type. Some of the anthers are merely flattened on one end; others are more so; while in others the anther has become a flat, white, petaloid disk on the end of a normal filament. From this, every gradation can be seen to the normal petal. In this instance, not only the pollen-walls, but the pollen itself, has become petaloid before the filament has been at all modified. In the flowers of the mock-orange (*Philadelphus coronarius*) the same transition often occurs, as well as in many of the double flowers of our gardens and conservatories.

CLARENCE M. WEED.

Agricultural college, Lansing, Mich.

Metallic circuits in cables.

When the full text of Mr. Gisborne's paper, read before the Royal society of Canada, is published, it will be shown that his anti-induction experiments with all metallic circuits in underground cables were made in connection with an electric target, for which a prize medal was awarded to him at the London exposition of 1862; and the diagrams attached to his paper will also explain why parallel metallic circuits in a *multiple* cable, unless twisted according to his design, will *not* eliminate induction of currents in

neighboring circuits. Submarine metallic circuits, both insulated and *uninsulated*, and operated upon the open-circuit system, were also experimented upon by Mr. Gisborne, in conjunction with the late Hon. F. O. J. Smith of Maine, during 1858-59, all of these experiments being upon record. D. H. K.

Too big to swallow.

Some young men standing on the shore of the Mississippi, June 27, near this place, saw something singular on the water. On going out to it with a boat, they captured it, and it proved to be a catfish with a land-tortoise in its mouth. The fish weighed a little less than twenty pounds. The turtle was about five inches across the back. It was fast within the jaws of the fish, requiring considerable force to extricate it. It was dead. The fish was in a demoralized condition, allowing itself to be captured with the hands.

P. J. FARNSWORTH.

Clinton, Io., July 3.

The gyration of a vibrating pendulum.

Referring to Mr. Hendricks's note on the gyration of a vibrating pendulum, in which reference is made to one of my statements, I wish to state that in the original paper the expression of τ by oversight was

$$\tau = \sec \theta \times \text{one day.}$$

The error was discovered soon after printing. When this was corrected in the reprint, it was not observed that it would make the sentence quoted by Mr. Hendricks state what was never intended.

W. FERREL.

HIGHER EDUCATION AND THE MASSES.

A POPULAR fallacy in respect to the worth of the higher education has rarely been so clearly put as it is by that master of fallacies, Gen. Benjamin F. Butler. In his recent response to an invitation from the National educational association to attend the convention in Madison, Wis., he says, "The higher education of the few mainly affects themselves; but *the education of the masses, which shall leaven the whole lump*, is the foundation upon which the permanency of our government must rest at last." In other words, Gen. Butler asserts that it is the dough, and not the yeast, which acts as the leaven.

Every intelligent patriot is in favor of popular education, but who are to be the teachers of the people? Gen. Butler replies, "It is the education of the masses which shall leaven the lump." The boy is to lift himself over the fence by pulling at the straps of his boots.

It is not even true in politics that the masses leaven the lump: it is the men of intellect who instruct and persuade and incite the mul-

titudes to united action. In literature and science it is quite as absurd to say that "the higher education of the few mainly affects themselves." A doctrine more fatal to the progress of knowledge, or more pernicious to the welfare of the people, could hardly be uttered by an intellectual demagogue. Did the higher education of Plato, Aristotle, Euclid, Pliny, 'mainly affect themselves'? Did the higher education of Homer, Dante, Virgil, Shakspeare, 'mainly affect themselves'? How was it with Columbus, Luther, Newton, Bacon, Faraday, — did their higher education 'mainly affect themselves'? For whose benefit all the researches of Pasteur and Koch, — 'mainly themselves'?

If Gen. Butler were alone in cherishing the fallacy that advanced education is a luxury, which pleases a few impracticable souls, and does no good to the masses, his words might pass unnoticed by *Science*; but this deceptive doctrine sways many, even, of those who are devoted to teaching. It crops out in educational conventions and in educational journals. The fallacy should be pointed out whenever it is uttered. The progress of the masses, the improvement of any age or any people, depends upon great men; great men are nurtured by great ideas; great ideas are developed by higher education, — the education which goes beyond that which is obvious to the abstract and fundamental, — the education which raises hard questions in respect to the unknown, and proceeds to seek the answer, confident that the discovery of every great truth will sooner or later contribute to the welfare of mankind.

This is an education which does not mainly affect the few and cultivated: it elevates the masses. If this truth should ever become clearly understood by our countrymen, they will do as much for higher education as they have done for popular instruction; and a happy day it will be for American civilization. Universities and schools of science will flourish as they have never done before; the government will be served by men who know, and not by men who guess; the public health, intelligence, morality, and prosperity will all be promoted.

THE AMERICAN INITIATIVE IN METHODS OF DEEP-SEA DREDGING.

THE published records respecting the use of dredges for natural-history purposes carry us back to scarcely more than a century and a quarter ago, when Otho Frederick Müller, a prominent Danish naturalist, began his studies of the aquatic life inhabiting the coasts of Norway and Denmark below the shore-level. The dredge he used, a very simple affair, was, so far as we know, the first one ever devised for the special needs of the naturalist; and yet, with only a single important modification, as to the shape of the frame, it has been handed down to our time as the most efficient appliance for the ordinary purposes of dredging.

As described and figured in 1779, it consisted of a plain rectangular iron frame, with all four sides of equal length, and bevelled to sharp edges in front, forming the mouth-piece to a large and open net. Four handles extended forward from the angles, and met in a single ring for the attachment of the drag-rope. The principal defect of this dredge consisted in its very wide mouth, permitting the easy escape of specimens, both while dragging and during the hauling-in.

Although Müller's researches were confined to shallow water, apparently not exceeding a depth of thirty fathoms, they established a precedent for subsequent operations, and afforded proof of the value of submarine collecting.

This new field of exploration did not, however, begin to enlist the active services of working naturalists to any extent until about the third or fourth decade of the present century, since which time the interest in marine zoölogical research has rapidly increased, and our knowledge of the sea-bottom has been extended to the deepest known areas. For the first thirty or forty years, the improvement in methods of work scarcely kept pace with the progress of knowledge regarding the inhabitants of the sea; and it is only within the past fifteen years that the methods of deep-sea dredging have been at all perfected.

To Dr. Robert Ball of Dublin, who was afterwards associated with Professor Edward Forbes in his memorable explorations, has generally been given the credit of having devised, about 1838, the improved form of naturalists' dredge, in nearly the same shape in which it is used to-day. However that may be, it was about the year last mentioned that both European and American naturalists entered actively into the study of the sea-bottom; and the history of their various exploits down to the pres-

ent time affords an exceedingly interesting chapter upon which the subject of our paper permits us to touch but slightly.

It may be well to remark, however, that the character and results of European, and especially British, exploration are much more widely and popularly known than are those of our own country. The reason is obvious. The active mercantile pursuits of a young and progressive people have naturally made them less appreciative of scientific facts and results than the inhabitants of many older countries, where business interests have fewer claims upon all classes. There has been but a slight demand for popular writings upon such an unpractical subject, and the plodding naturalist has generally been content to record his observations and methods where they were accessible only to his brother-workers. For this reason, American naturalists have not received the credit which is their due, either at home or abroad; and much of the honor that justly belongs to them has passed into other hands.

So far as concerns the general public, this is not to be wondered at, when we consider that the only popular accounts of deep-sea dredging explorations obtainable in this country are of English origin. But the same excuse does not hold good for the working naturalists of any country, including our own; as the progress of American deep-sea research, and the improvements in methods for carrying it on, have in nearly all instances been duly and promptly recorded in the proper channels to insure wide and timely distribution.

Since the very beginning of activity in this branch of investigation, American workers have not been far behind those of any European country; and their record is as creditable. Dredging was carried on by the Wilkes U. S. exploring expedition during the early part of its cruise, beginning in 1838; and at about this same time a few of our most earnest naturalists were using the dredge at home. The late Dr. William Stimpson, one of the most intelligent observers in this branch, and whose name is closely linked with several important explorations, began his career in Boston harbor between 1848 and 1850; his first instructions having been received from Dr. W. O. Ayres, who began dredging fully ten years before. Stimpson's researches were largely conducted under government auspices; and the collection of submarine specimens resulting from his labors, distributed over many portions of the Atlantic and Pacific Oceans, was probably one of the very largest of its kind that had been made, up to the time of its unfortunate destruc-

tion by fire at Chicago, in 1871. The loss of these collections, and of all the voluminous manuscript reports treating of them, followed by the sad death of the author, has deprived our country of a most important chapter in the history of submarine exploration.

The sixth decade of this century, however, brought out many additional investigators; and a fresh impetus was given to the work, which has since been expanded and developed to such an extent as to establish, beyond all question, American precedence in the methods of deep-sea research at least, both as regards dredging and sounding.

From among the more energetic and successful of our modern dredgers may be mentioned Prof. A. E. Verrill of Yale college, whose dredging studies began in 1864, on the coast of Maine, and who, since the organization of the U. S. fish-commission, has been its main helper and adviser in all matters pertaining to submarine research, the special direction of the dredging operations having been intrusted to him from the beginning. His earlier experiences gave him a clear insight into the requirements of the new project, and enabled him to devise many valuable appliances, and improve upon those which had been in use. To his zealous and untiring efforts is due much of the perfection in present methods of work.

In 1867 Mr. L. F. de Pourtalès, of the U. S. coast-survey, began the extensive series of deep-sea explorations off the southern coast of the United States, which were carried on for several years, and subsequently led to the eventful cruises of the steamer *Blake* between 1877 and 1880, resulting in an entire revolution in the methods of deep-sea dredging and sounding. The investigations of Mr. Pourtalès anticipated, by a year, those of the English steamers *Lightning* and *Porcupine*, which have been so widely described, and were preceded by only one series of systematic dredgings in equal depths of water,—those of the Professors Sars, father and son, of Norway. But little credit for this fact has been received from naturalists abroad; the date of Mr. Pourtalès' first cruise being generally regarded by them as 1868, although his first paper, descriptive of the character of his work, and of many new forms of deep-sea animals, appeared in December, 1867.¹ His collections, representing principally the fauna of the Gulf Stream off Florida, gave new and interesting results; going farther to prove the existence of a rich and

diversified deep-sea fauna, different from that of the shore regions, than any previously obtained.

That these dredgings were not undertaken to please the passing whim of some over-enthusiastic naturalist, but were as deliberately planned and carried out, and as successful in their results, as those of the English steamers which followed them in conception, a reference to the official publications of the coast-survey will sufficiently prove. As substantiating this statement, we may be pardoned for quoting a short paragraph from the report of Mr. Pourtalès, above referred to (December, 1867), in which the plans and objects of the new explorations are briefly stated. This would not be called for, were it not that it is this identical report which has been so utterly ignored by European writers, and equally overlooked by many American. Had it only been written in popular language, and been published with copious illustrations, it might have received the credit which has been denied it; but such channels of publication are seldom deemed necessary to establish priority in scientific research.

The plan of operations, according to Mr. Pourtalès, was as follows:—

“The present superintendent of the coast-survey, Prof. B. Peirce, has lately directed the resumption of the investigations of the Gulf Stream, so successfully inaugurated by his predecessor, but interrupted for several years by the war. Besides observations of the depth, velocity, and direction of that current, and the temperature and density of the water at different depths, the researches will be extended to the fauna of the bottom, of the surface, and of the intervening depths. Not only will an insight be thus obtained into a world scarcely known heretofore, but that knowledge will have a direct bearing on many of the phenomena of that great current. Thus a new light may be thrown on its powers of transportation from shallow to deeper water or along its bed, on its action in forming deposits in particular localities, or on its possible influence on the growth of coral-reefs on its shores.”

In a subsequent passage, he summarizes his first season's results in the following terse remarks, the italics being his own:—

“However, short as the season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great a diversity and as great an abundance as in shallow water.*”

Early in the following year (1868) the same

¹ *Bulletin Mus. comp. zool. Cambridge*, vol. i., 1863-69, pp. 103-120.

explorations were resumed, and they were continued through 1869.

It may be thought that we have departed too widely from our subject in discussing with so much detail the progress of American research during a period in which no great improvements were made in methods of work on this side of the Atlantic; but how could we have better furnished proof of the rapid growth of interest in such matters, and of the maturing of ideas which prepared the way for the important changes marking the next decade?

There is, however, one noteworthy addition to the collector's outfit made in this period, which deserves special mention. On one of the dredging cruises of the English exploring steamer *Porcupine*, between 1868 and 1870, Capt. Calver, the naval officer in charge, attached several of the common deck-swabs to the end of the dredge-net, with the expectation, that, in sweeping the ocean-bottom, they would securely entangle all the rough and spiny objects lying loose within their path. His fondest hopes were realized; and the novel experiment, suggested by often finding such objects as sea-urchins, corals, and sponges, adhering to the exterior of the dredge-net, and even to the lower part of the drag-rope, gave origin to one of the most efficient implements of modern deep-sea research.

When the beam-trawl, a well-known English appliance for the capture of bottom-fish, was first adopted into the outfit of the marine zoölogist, we are unable to state; but it does not appear to have ever been extensively and systematically employed in scientific research until so used by the U. S. fish-commission, beginning in 1872. It was afterwards used by the *Challenger* from 1873 to 1878, and now greatly excels the dredge in the extent and value of its results, wherever the ground is suited to its use.

The year 1871 was signalized by the organization of the U. S. fish-commission, one of the most important scientific establishments of modern times for marine zoölogical work. Although instituted primarily for the investigation of fishery matters, it has, through the wise and liberal policy of its director, Professor Baird, accomplished most valuable results for marine biology. The latter department has been sedulously fostered, in the belief that its results would have an important bearing upon the practical questions at issue. No pains have been spared to perfect the methods of research, and many valuable contributions have already been made to the marine collector's outfit. These are briefly described below; and, as the history of the commission is already well

known to most readers, we need refer here to only a few points which have marked its progress.

The earlier explorations were carried on mainly by means of sail-boats, and were confined to comparatively shallow water. From 1873 to 1879 a naval tug was placed at the disposal of the commission every year; but in 1880 the steamer *Fish Hawk*, a twin-screw propeller of two hundred and five tons (*n.m.*), was built expressly for the combined purposes of fish hatching and dredging. Its small size and light draught prevented long trips at sea; but it was well adapted for deep-sea work, and was supplied with all the improved appliances, as well as those which had originated with the commission, including wire rope, then recently introduced by the coast-survey. In 1883 the steamer *Albatross*, described in vol. ii. of *Science* (pp. 6, 66), was completed, and made her first successful cruise in the spring of that year. Her log for the summer of 1883 records the deepest trawling yet made in the Atlantic Ocean; the depth having been 2,949 fathoms, and the results successful. Brief accounts of her dredging cruises under Lieut.-Commander Tanner, U.S.N., have appeared from time to time in late numbers of *Science*.

While the fish-commission claims priority for many improvements in apparatus primarily intended for depths under a thousand fathoms, it willingly yields the palm for deep-sea improvements to the U. S. coast-survey, especially in the persons of Commander Sigbee, U.S.N., and Mr. Agassiz. The explorations of the steamer *Blake* from 1877 to 1880, in which the methods of deep-sea dredging and sounding were completely revolutionized, mark one of the most important stages in the progress of marine research. Wire rope was substituted for hemp, the dredge was altered to adapt it to the soft bottoms of deep water, on which dredging results had always been uncertain, and the beam-trawl was made reversible. The methods of handling and reeling the rope were also perfected. These changes and additions were briefly described and figured from time to time, as work progressed, in the *Bulletin of the Museum of comparative zoölogy*, at Cambridge, by Mr. Agassiz and Mr. Sigbee, and were afterwards fully discussed by the latter in one of the most elaborate and instructive reports ever dedicated to the methods of deep-sea research.¹ It is a quarto volume of two

¹ Deep-sea sounding and dredging: a description and discussion of the methods and appliances used on board the coast and geodetic survey steamer *Blake*. By CHARLES D. SIGSBEE, lieutenant-commander U. S. navy, assistant on the coast and geodetic survey. Washington, 1880.

hundred and eight pages and forty-one plates, describing the sounding and dredging appliances used by the Blake, and which, for the greater part, were devised or improved during her dredging cruise. So far as her dredging appliances are concerned, the credit for changes made belongs mostly to Mr. Sigsbee and Mr. Agassiz; the former having been in command of the expedition, and the latter in charge of the natural-history operations.

During the seventh decade, European explorers were not idle, and numerous deep-sea expeditions were fitted out. Most notable among these was the cruise of the British ship Challenger around the world between 1873 and 1878. Her scientific results were most interesting; but the older methods of deep-sea work were not greatly altered, although the practicability of using the beam-trawl successfully in the deepest water was fully demonstrated.

In 1881 the French government inaugurated a series of submarine explorations in the Atlantic Ocean and Mediterranean Sea; for that purpose fitting out a small naval vessel, the Travailleur, and placing the management of affairs in the hands of a competent scientific staff, under the directorship of Prof. A. Milne-Edwards. These investigations were continued by the same vessel during 1882, the appliances and methods of work having apparently been patterned after those generally recognized in Europe. In 1883 a larger vessel, the Talisman, was assigned to the work, and operations were established on a much grander scale than before.

For an account of these explorations, descriptive of the methods of work and general results, we are indebted to the last volume of *La Nature*, a French journal of the character of *Science*, which began in a January number the publication of a series of articles by one of the naturalists who accompanied the steamer.¹ Coming from such an authoritative source, we are led to regard these papers almost in the light of a semi-official report, and look to them for at least a correct statement regarding the origin of their methods of work, inasmuch as these matters are discussed in some detail, and with evident pride at the completeness of the outfit. That the outfit was complete, no one who is at all posted on the subject can deny; for nearly all of the many improvements introduced by the coast-survey and fish-commission prior to 1880 are most faithfully copied, and most heartily

praised for their perfect adaptation to the requirements of research.

We glance through the several pages of the report for at least some slight acknowledgment on behalf of American inventive skill; but beyond a brief statement to the effect that the hoisting-engine "was of the same type as that employed by Mr. Agassiz," and that he also "used with good results the common form of beam-trawl," we are left to infer that the entire outfit was of French origin; and such must be the impression of every one who reads these papers. In fact, in several instances, credit is explicitly bestowed on French inventors for certain of the appliances which do not differ in any essential features from the corresponding American patterns.

What is to be gained by thus appropriating to the credit of a nation what properly belongs to another and a friendly one, by all the rights of international courtesy, it is difficult to understand, and especially so in this age of supposed enlightenment, when every important discovery is carried with lightning rapidity to all parts of the civilized world. The field of marine research is sufficiently broad to engage the entire attention of all the naturalists who have yet entered it; and the frequent manifestations of jealousy on the part of foreign, and especially French investigators, which often result in wholly ignoring the works of an able American author, can but retard progress instead of aiding it.

Proofs of the superior excellence of American methods of deep-sea research may be found in every important scientific library of Europe as well as this country; and at the two most prominent international fisheries exhibitions of the world, — those of Berlin in 1880, and London in 1883, — all of the American appliances were displayed, and received the highest awards. They have therefore been made sufficiently well known to establish their merits before the scientific world; but, as no descriptions of them have yet been published for the benefit of the general public, we propose in future numbers of *Science* to give accounts of their construction, and of the causes which lead to their introduction.

RICHARD RATHBUN.

SPECIAL MANURES FOR PARTICULAR CROPS.

THE fact that the percentages of nitrogen and of the several ash ingredients vary quite widely in different plants (legumes being rich in nitrogen, cere-

¹ For an abstract of the portion relating to the apparatus employed, see *Science*, No. 62.

als in phosphoric acid, and root-crops in potash) has frequently led to the compounding of so-called special fertilizers or manures, intended to be particularly adapted to the growth of certain crops. The starting-point in the preparation of such fertilizers has usually been Liebig's 'restitution theory' (*ersatz-lehre*), according to which the soil must be manured with the same quantities of fertilizing materials as are removed by the crops produced. On this theory, a special manure for beans would contain much nitrogen, and one for corn or wheat much phosphoric acid. Such special manures were first brought prominently into notice in this country by Professor Stockbridge of the Massachusetts agricultural college, and, for the last few years, have enjoyed great popularity, almost every prominent fertilizer-manufacturer producing fertilizers for all conceivable crops, even to orange-trees. These fertilizers have seldom had the same composition in two successive years; and those of each maker have differed from those of every other, thus affording to consumers an abundant variety from which to choose.

It is not proposed here to enter into a consideration of all the numerous fallacies involved in the use of special manures, but only to present the results of some recent experiments, which have an important bearing upon the fundamental idea of such fertilizers. This idea is, in brief, that crops must be manured most abundantly with those elements which they contain most abundantly. There are not wanting, however, indications that this is not altogether true. For example: wheat contains, on the average, about half as much nitrogen as clover; yet experience has shown that wheat is greatly benefited by nitrogenous manures, while clover is comparatively indifferent to them. Indeed, it is a common practice to grow wheat after clover, using the latter crop to gather nitrogen for the former. Many other similar cases might be cited; and it is a noteworthy fact that many special manures, while professing to be compounded on the theory stated above, are, in fact, modified to correspond with these teachings of experience.

All this suggests that one important factor in determining the most suitable manuring for any crop is the power which that crop has of gathering its supplies from natural sources. Paul Wagner has recently published¹ some investigations upon this subject, which are interesting, both in themselves and in their suggestions for future work. He compared peas and barley, growing them in zinc vessels twenty-five centimetres high and twenty-five centimetres in diameter. These vessels were uniformly filled with carefully mixed and sifted soil, were provided with a constant water-supply, and, in short, differed only in the manuring which they received.

The following manurings were given in each series: No. 1, nothing; No. 2, nitrogen; No. 3, potash; No. 4, phosphoric acid; No. 5, phosphoric acid and nitrogen; No. 6, nitrogen and potash; No. 7, potash and phosphoric acid; No. 8, potash, nitrogen, and phosphoric acid. Each manuring was duplicated,

so that thirty-two vessels were used in all. Nitrogen was given in every case at the rate of 40 kilos per hectare, in the form of nitrate of soda; potash, at the rate of 80 kilos per hectare, in the form of chloride; phosphoric acid, at the rate of 100 kilos per hectare, in the form of superphosphate. The duplicate manurings gave reasonably accordant results, and the author estimates the limits of error at 3% of the total yield. The following table shows the *relative* yield of total air-dry matter (grain and straw), that of the unmanured vessels being taken as 100.

No.	Manuring.	Crop.	
		Peas.	Barley.
1	Nothing	100	100
2	Nitrogen	104	113
3	Potash	100	107
4	Phosphoric acid	126	113
5	Phosphoric acid and nitrogen	132	146
6	Nitrogen and potash	102	121
7	Potash and phosphoric acid	147	126
8	Potash, phosphoric acid, and nitrogen,	151	181

A study of these figures, remembering that differences of three or four per cent have no significance, leads to the following conclusions:—

The nitrogen had as good as no effect upon the peas (compare 1 with 2, 3 with 6, 4 with 5, and 7 with 8: the greatest difference is 6%). The same comparison for the barley shows that the nitrogen here had a very beneficial effect, the increase in the crop amounting to from 13% (nitrogen alone) to 55% (nitrogen in combination with potash and phosphoric acid). Interesting differences in the effect of potash and of phosphoric acid upon the two plants are also evident, but we pass over these for the present.

The nitrogen of the unmanured soil amounted to 13.77 grams in each vessel; that of the manuring, to 0.2 of a gram. The nitrogen of the unmanured soil was fully sufficient to supply the needs of the peas, as the following considerations show. There were produced —

	Dry matter.	Containing nitrogen.
Without manure	30.0 grams.	0.91 grams.
With nitrogen	31.3 "	0.95 "
With potash and phosphoric acid,	44.0 "	1.34 "
With potash, phosphoric acid, and nitrogen	45.2 "	1.37 "

That is to say, manuring with potash and phosphoric acid enabled the peas to produce 47% more dry matter, the 0.43 of a gram of nitrogen necessary for this increase being obtained as readily from the comparatively insoluble nitrogen of the soil as from the soluble nitrogen added as manure.

For the production of barley, the figures stand as follows:—

¹ *Landw. jahrbücher*, xii. 717.

	Dry matter.	Containing nitrogen.
Without manure	13.5 grams.	0.23 grams.
With nitrogen	15.3 "	0.26 "
With potash and phosphoric acid, 17.0 "		0.29 "
With potash, phosphoric acid, and nitrogen	24.4 "	0.41 "

The nitrogen of the unmanured soil was not sufficient to fully supply the needs of the barley; for while manuring with potash and phosphoric acid only enabled it to produce 26% more dry matter, containing 0.06 of a gram of nitrogen, the addition of 0.2 of a gram of soluble nitrogen enabled it to show an increase of 81% of dry matter, containing 0.18 of a gram of nitrogen.

These facts admit of but one conclusion; viz., that peas are able to assimilate the nitrogen contained in the soil much more readily than is barley. The fact that the pea-plant contains much more nitrogen than the barley-plant does not show that peas should receive much more nitrogenous manure than barley, but, on the contrary, that they can readily supply themselves with nitrogen, but need to be manured with potash, and particularly with phosphoric acid. Barley, on the other hand, contains little nitrogen, partly because it cannot gather it readily, and therefore it needs an artificial supply. In other words, the greater need of nitrogen on the part of the peas corresponds to a greater power of obtaining it.

It is, of course, unsafe to generalize from these two experiments. At the same time, their results correspond so exactly with the teachings of experience regarding the most suitable manuring for legumes and cereals respectively, and appear *a priori* so probable, that one can hardly avoid a strong belief in their general application. They certainly open an interesting and important field for further research. If it can be shown, that, in manuring any given plant, we ought to direct our attention more particularly to those elements of its food which it contains in relatively small quantity rather than to those present in abundance, we shall have made a very considerable advance in our knowledge of the theory of manures.

H. P. ARMSBY.

KOCH'S WORK UPON TUBERCULOSIS, AND THE PRESENT CONDITION OF THE QUESTION.

THE question of the cause of that form of disease known as tuberculosis is one which has been the subject of discussion in medical circles for many years. It is of especial interest to the laity, because in one of its forms it includes the affection so widely known as consumption of the lungs, or phthisis. The idea of a contagious nature as belonging to this process, i.e., to tuberculosis, was first broached in modern times by Villemin,¹ as the result of a series of

experiments upon animals, conducted by him. These experiments attracted very great attention at the time, and were subsequently repeated, with varying degrees of success and failure, by numerous observers. Twenty-five years before Villemin's experiments were announced, Klencke¹ claimed to have produced tuberculosis in animals (rabbits) by the inoculation of tuberculous matter. His results do not, however, seem to have received the attention which they deserved; and it is to Villemin that is usually ascribed the beginning of the line of experiment which has resulted in the work which is under consideration to-day.

Among those who have taken up the question of the specific nature of tuberculosis in inoculation experiments, may be especially mentioned Waldenburg, Klebs, Cohnheim, Fränkel, and Baumgarten. Inhalation experiments, in which the disease is sought to be communicated by forcing animals to inhale finely divided dried tuberculous materials, have been tried again and again with as conflicting results as in the preceding series. Those who have done the most noteworthy work in this direction are Schottelius, Tappeiner, Weigert, Weichselbaum, and Balogh.

Feeding-experiments form the third class by which an endeavor to obtain evidence for or against the specific nature of tuberculosis has been made. It is unnecessary to do more than mention the names of a few of those who have taken a prominent part in this branch of the investigation: such are Aufrecht, Klebs, Bollinger, Colin, Tappeiner, and Toussaint.

These names, forming but a small part of the catalogue of those who have been interested in the study of tuberculosis, will give some indication of the vast amount of work done, and the interest taken in this subject.

After Villemin's experiments, and coincident with all the work that was called out by them, the question of the *nature* of the virus of tuberculosis was eagerly discussed. The idea of a *contagium vivum* was first suggested by Buhl,² who claimed to have observed micro-organisms constantly occurring in tuberculous nodules; these micro-organisms being both micrococci and bacteria. This idea was taken up by Klebs,³ who claimed to have isolated a micrococcus by culture, and to have produced tuberculosis by the inoculation of this organism. Klebs's experiments were repeated, and with the same, or nearly the same, successful results, by Schneller,⁴ Reinstadler,⁵ and Deutschmann.⁶ The acceptance of this monas tuberculorum, as it was called, as the specific cause of the tuberculous process, was not general, however; and for various reasons the work of Klebs seems to be untrustworthy.

¹ Untersuchungen un erfahrungen, etc. Von Professor KLENCKE. Leipzig, 1843. Bd. i.

² Lungenentzündung, tuberculose, und schwindsucht, 1873.

³ Prager med. wochenschrift, 1877, Nos. 42 and 43.

⁴ Ueber therapeutische versuche. Arch. für exp. pathol., bd. xi., 1879. Exp. und histolog. untersuchung über die entstehung der tuberculose, etc., 1880.

⁵ Arch. für exp. pathol., bd. xi., 1879.

⁶ Med. centralblatt, No. 18, 1881.

¹ Gazette médicale de Paris, December, 1865. Études sur la tuberculose. Paris, 1868.

While all these investigations were going on, and the contradictory and conflicting results derived from them were being given to the world, other experiments were being conducted, the results of which were not announced as the work progressed, but were kept from publication until they had been verified in the most complete manner that modern methods would permit. These experiments were those of Robert Koch, conducted by him at the laboratory of the German board of health in Berlin, and pursued with unremitting diligence and care for over two years. The results were first made public under the modest title of 'The etiology of tuberculosis,' at a meeting of the Berlin physiological society in March, 1882, and were published in the *Berliner klinische wochenschrift*, 1882, No. 15. His method of work was as follows:—

Starting with the assumption that a micro-organism might be at the bottom of the disease, he carefully searched for some evidence to support this theory by microscopic investigation of large numbers of tuberculous tissues from various sources. As a result, he found, that with favorable illumination of the specimen, and good lenses, it was possible to make out the almost constant presence, in tuberculous tissues, of a rod-like organism much smaller and finer than most of those that had hitherto been observed. The occurrence of this organism was found to be so frequent, and in such early stages of the disease, that a suspicion of its causal relation to the pathological process was forced upon him.

The discovery of the existence of this bacterium was but the beginning of the investigation, however; and the masterly series of experiments by which he went on to prove its specific relationship must be read to be appreciated.

In the first place, it was necessary to isolate this organism from its surroundings, and to propagate it by itself; that is, to produce a 'pure culture.' The best means to do this could only be ascertained by experiment; and, after the conclusion of these experiments, his results were these. The organism was found to flourish best at a temperature of from 36° to 40° C., — a much higher range than is necessary for most forms of bacteria. This being ascertained, it was necessary to find some suitable culture-soil upon which the organism could flourish; for the ordinary gelatine media would not remain solid at this temperature. Here it was found that the serum of the blood of sheep or cattle was the best medium to be employed; for, by exposure to a comparatively low temperature (65° C.), it would gradually solidify, until, at the end of a few hours of such exposure, it would become a transparent, amber-colored mass of a jelly-like consistency, of course remaining solid at a lower temperature for any length of time. After this was done, there was still another peculiarity of this organism to be appreciated, and that was its slow growth. Up to this time, bacteria were supposed to complete the cycle of their existence in a very short time, — usually measured by minutes, occasionally by hours. In this case, however, there was something entirely different; and it was not until after a

large number of experiments had failed, that it was realized that they were dealing with an organism requiring from a week to ten days for any appreciable increase in its numbers to occur.

Having found out all these peculiarities, it remained to study what happened in the culture-apparatus, as time went on. It was found that it required from two to three weeks for such a growth to take place upon the surface of the culture-medium; that a portion could be transferred to another nutritive soil, and a new culture started: it was found that the growth occurred in dry, whitish-gray scales, that, under a low power of the microscope, were seen to be rather of a sigmoid form; and it was found that when these scales were transferred to other soil and broken up, each fragment would produce like scales, and that this method of propagation could be kept up for months at a time. Inoculation of animals of various kinds with material from these cultures at any and all stages of their growth, done under the most rigid precautions for the exclusion of any impurities, or possibly specific matter, was found invariably to produce the disease tuberculosis. The tissues of these animals, when killed, presented the nodular appearances peculiar to the disease; and in these nodules were always found organisms exactly similar to those which had been injected. Cultures of these organisms showed exactly the same peculiarities as in the first instance; and inoculations with the result of these cultures produced the same pathological appearances.

In order to prove that these organisms *alone* would produce the disease, Koch used other substances than tuberculous matter for inoculation; and these substances being proven by microscopic examination to contain no organisms, and being protected from external contamination by all known precautions, gave entirely negative results, and in no case was tuberculosis produced. On the other hand, in no case was there a failure to produce the disease, when materials containing the organism, or the organism itself, were employed as the inoculating material.

Thus it will be seen that the conditions necessary for the establishment of a specific causal relationship between a micro-organism and a given disease were fulfilled in this case, so far as it was possible for one observer to bring them about. The constant occurrence of an organism in the varying forms of the disease in animals and in man; its isolation from the tissues, and reproduction by artificial means; its introduction into healthy animals, with the resulting pathological processes exactly similar to the original disease; its discovery in these inoculated animals; and its re-isolation and observation, — all these requirements have been repeatedly fulfilled in the case of the bacillus of tuberculosis, together with that other trying one, that materials proven to contain no bacilli invariably fail to act in any specific manner.

Not content with the work thus announced, Koch went on for a year longer with his experiments, the results of which were collected in July of last year, but have only recently reached American readers

in the second volume of the German health reports.¹ In this article, Koch re-affirms his original announcement, and gives the results of further work in the same direction, all reached by experiments conducted with the same precision as the first series. They bear out his assertions to the full, and with the exception of a few slight changes of technique, and a modification of the staining methods employed, have led him to no change whatever in regard to his views as first expressed more than two years ago.

These two papers taken together form a monument of scientific accuracy and care, and, so far as subsequent investigations go, will carry conviction to the mind of any impartial judge. Confirmatory evidence, as regards the occurrence of the organism in question in tuberculous lesions, has been offered upon all sides, and in enormous mass. The real evidence, however, the repetition of the culture and inoculation experiments, is sadly deficient. This is, perhaps, not to be wondered at, because the apparatus necessary is so extensive, the training so severe, and the aptitude for the work so rare. In addition to all this, the time necessary for the experiments is so great, that the chances are that they never will be repeated to their full extent, although it is only by such thorough and exhaustive investigation that progress in this branch of scientific medicine can be expected.

Some few observers have pretended to upset the conclusions of Koch upon the basis of extremely unsatisfactory and incomplete observations. Spina of Vienna is, or was, a prominent champion of this class. His book was announced with a flourish as being intended to overturn, and as actually accomplishing the destruction of, all Koch's theories. Upon its publication, it was found to be nothing but a criticism of methods that Koch himself acknowledged to be faulty, and a few observations upon the occurrence of the bacillus, but with an entire absence of any culture, or properly conducted inoculation, experiments whatever; in all respects being so far below the work it was meant to criticise, that it was with pain and mortification that we heard it mentioned on the same plane, in the annual address to the Massachusetts medical society of this year. This, however, seems to be the limit of any noteworthy objections in Europe: in this country it is different, a number of gentlemen having considered themselves authorized to speak in opposition to Koch's views upon the ground of personal observations. For the most part, however, their pretensions are too weak to receive serious notice: as, for example, Schmidt's cry of 'fat crystals;' Gregg's, of 'fibrine filaments;' Cutter's, of 'Mycoderma aceti;' or Formad's, of 'narrow lymph-spaces.' It is, perhaps, hardly fair to speak of Formad's deplorable failure to maintain his opposition to Koch by any reasonable arguments at the last annual session of the American medical association. Through imperfect counsel, the gentleman was induced to come before the meeting, and after announcing far and wide his intention to give

results that would destroy the last vestige of strength to Koch's assertion in regard to the specific nature of the bacillus of tuberculosis, instead of doing this, proceeded to read a reprint of an article published by him last fall, announcing that his results would be published in the near future. This, in the present condition of all questions relating to micro-organisms in this country, seems to be almost inexcusable. These results have been promised for months, and at the time of writing have not yet appeared. It seems as if it were the bounden duty of all those honestly interested in the advancement of scientific knowledge to talk and publish less, and to work more. What is needed is the publication of the results of work carefully and conscientiously performed, together with the exact details of every step in every process by which those results were reached. In addition to this, we have a right to demand that all work of this kind shall be done by trained observers, in the presence of others equally well qualified for the observation,—not with and by half-trained students,—and that the very best appliances of modern research shall be employed in each and every observation made. In this way, and in this way only, can reliance be placed upon observations recorded in work on micro-organisms; and it is the absence of work of this kind which gives so very little force to the opponents of the specific nature of the bacillus of tuberculosis. At the same time, it is the presence of this very accuracy of the detailed account of every step in the process by which the results were reached, and of the completeness of the experiments and control experiments, that gives the convincing power to Koch's work. Nothing that can be for an instant compared with it for simplicity and directness of statement, or completeness of detail, has yet been brought forward by his opponents. Until that is done, and it does not look probable at the present writing, his work must be accepted as conclusive; and measures should be taken to control to some extent the wide-spread destruction of this disease, as it is most certainly within our power to do.

Koch's own work upon the subject of tuberculosis has been suspended for a year, owing to his absence in the east with the German cholera commission, with which he has lately returned. Whether he himself will take it up again is to be doubted; for his facilities for work are unbounded, and his natural impulse will, of course, be to open up untrodden paths of research.

THE GREENWICH OBSERVATORY.

THE board of visitors of this institution held its annual session on Saturday, June 14, and heard the report of the astronomer royal on the work of the observatory during the twelve-month ended May 20. Of this, Mr. Christie says, "It has gone on steadily in the same lines as in former years, with such small extensions in certain directions as could be made without infringing the long-established principle that

¹ *Mittheilungen aus dem rais. gesundheit*, bd. ii., 1884.

all observations are to be reduced and published without delay."

The fundamental instrument, the transit circle, has been kept well at work on the regular observations of the sun, the moon, the planets and fundamental stars, together with other stars, which, in the annual catalogue for 1883, number 1,550. The total number of transits observed was 5,213, and of circle-observations, 5,049, — a larger number of meridian observations than usual. But what is of more interest, the reductions of these observations are maintained in a state of forwardness unknown in national observatories generally. The computations on certain stages of the reductions of the meridian-work were reported to be well advanced on all observations up to the middle of May, 1884. It is worthy of note here, that the mean correction of the 'Nautical almanac' positions of the moon in right ascension turns out to be no larger than -0.03 for the year 1883. This interesting concordance of theory and observation is due to the adoption in the 'Nautical almanac' of Professor Newcomb's corrections to the 'Tables de la lune' of Hansen, which are the same as those employed in the construction of the 'American ephemeris.'

The observations with the altazimuth have been restricted to the period from the last quarter of the moon to the first quarter in each lunation; it being considered, that, from the first quarter to the last, the observations of the moon on the meridian will be obtained in sufficient abundance. The astronomer royal regards it as evidence of the great value of the altazimuth, that, during the former period, nineteen observations of the moon were secured with it at times when the moon's meridian-passage took place within three hours of the sun, and when observation with the transit circle was thus impracticable.

With the equatorially mounted refracting telescopes, only the usual observations were conducted; but, with the spectroscope, results of much importance and interest were reached. "For the determination of motions of stars in the line of sight, four hundred and twelve measures have been made of the displacement of the *F* line in the spectra of forty-eight stars, ninety-one measures of the *b* lines in nineteen stars, and two measures of the *D* lines in one star, besides measures of the displacements of the *b* and *F* lines in the spectra of the east and west limbs of Jupiter, and in the spectra of Venus and Mars. . . . Some preliminary measures have also been made of the *F* line in the spectrum of the Orion nebula. The progressive change in the motion of Sirius from recession to approach, alluded to in the last two reports, is fully confirmed by numerous observations since last autumn, and a change of the same character is indicated in the case of Procyon."

With regard to solar photography, undertaken with the view to determine the amount of spotted area, it is interesting to note that the heliograph, which up to the present time has given pictures of four inches diameter only, has been modified so as to take eight-inch pictures, as was suggested two years ago by the solar-physics committee. The photographs taken in

India under the auspices of the same committee are now sent to Greenwich for reduction, thus resulting in a considerable increase in the number of days for which photographs are available. In 1883, for example, photographs on 215 days at Greenwich are supplemented by those on 125 days of India, giving a total of 340. In 1882, to 201 days at Greenwich were added 142 India, thus leaving only 22 days without photographs in the entire year. In the photographic branch of the observatory-work there has been much pressure "during the long-continued maximum of sun-spots, the work of measuring the photographs having been somewhat further increased by the adoption of large-scale photographs of the sun."

The acquisition of the Lassell equatorial, and the uses to which the astronomer royal proposed putting it, were mentioned in the report of the previous year. A new dome for this telescope, thirty feet in diameter, and covered with *papier-maché* on a framework of iron, was completed by the Messrs. T. Cooke & Sons of York in March last; and the building is now about complete in all its details. The instrument itself has been generally cleaned and repaired. The mirror is in very good condition as regards polish, and the definition on stars is satisfactory.

The magnetic and meteorological observations have been continued with the same regularity as in previous years. The mean temperature of 1883 was $49^{\circ}.3$, being $0^{\circ}.4$ lower than the average. The highest air-temperature was $85^{\circ}.1$, on Aug. 21; and the lowest, $20^{\circ}.6$, on March 24. The mean daily motion of the air during the year was 291 miles, which is 12 miles more than the average. The number of hours of bright sunshine during 1883 was 1,241, being about 30 hours above the average of the six preceding years. Mr. Christie informs us that no definite connection was noticed between magnetic or electric disturbances and the phenomena of the remarkable sunsets of the past winter.

THE UNITED-STATES GEOLOGICAL SURVEY.

Annual reports of the United-States geological survey to the secretary of the interior, ii., iii. J. W. POWELL, director. Washington, Government, 1882-83. 55+588 p., 32 fig., 62 pl.; 18+564 p., 56 fig., 35+32 pl. 8°.

It has often been remarked that the problems of geology are expressed in far simpler terms in America than in Europe, the birthplace of the science. It is hard to say whether it would have been better for geology if it had been born in a less adverse environment. Perhaps it might have developed more rapidly, but probably not so healthily. Perhaps the very difficulties of the problems of geology in Europe — the conflicts of the schools through which the young science passed — have tended to invig-

orate its life. However this may be, there can be no doubt, that, this stage of pupilage passed, it was well that a new and larger field was opened here on this continent, where its activity might be more productive, and its growth more steady. On the North-American continent, and especially in the United States, it would seem that each separate geological problem is stated in the clearest way. In stratigraphy, where shall we find a series so continuous and complete as in the region of the Wahsatch Mountains? In mountain structure, where are the extreme types so perfectly expressed as in the Appalachian on the one hand, and the basin ranges on the other? In landscape, where are there examples so simple and grand as in the plateau region? Of the obscure phenomena of the glacial epoch, where may we hope to find an explanation, if not in eastern United States? In the still more obscure problems of chemical geology, such as the geneses of ore-deposits, — problems which have hitherto baffled the utmost efforts of science, — what field so promising as the American Cordilleras, where the process is still going on under our eyes? Finally, in paleontology, where are there fields richer than the paleozoic basin of the east, and the wonderful cretaceous and tertiary deposits of the west?

These reflections have been suggested by reading the two bulky volumes before us. There can be no doubt that the establishment of the U. S. geological survey is an epoch not only in the geology of this country, but in the science of geology itself. Excellent work has been done before by individual effort, by state surveys, and by surveys undertaken by the war and interior departments; but never before has the work been organized in a manner befitting so noble a field. The volumes before us are a proof of the excellence of the work being done: they consist of full abstracts of a series of monographs, most of which are yet unpublished. A simple enumeration of these is sufficient to show their great importance. They are Dutton's 'Physical history of the Grand Cañon district,' Gilbert's 'History of Lake Bonneville,' Russell's 'History of Lake Lahontan,' Hague's 'Geology of Eureka district,' Emons's 'Geology of Leadville district,' Becker's 'Geology of Comstock lode,' Irving's 'Copper-bearing rocks of Lake Superior,' and Chamberlin's 'Terminal moraine of the second glacial epoch.' It is evident that only the most rapid review of these memoirs is possible here.

The geology of the plateau region, through the labors of Powell and Dutton, is so well

known that only a brief recapitulation of its wonderful history is necessary. This region, now the highest in general elevation of the continent, was a sea-bottom, continuously or nearly so, from early carboniferous to the end of the cretaceous, and received, during this time, conformable sediments twelve thousand to fifteen thousand feet thick: this indicates, of course, a subsidence to the same extent. At the end of the cretaceous it began to rise, passing successively through brackish-water, fresh-water, land, and high-plateau conditions to the present time, the extreme elevation being not less than eighteen thousand to twenty thousand feet. Accompanying this elevation, and as its effect, there has been a general erosion by which from six thousand to eleven thousand feet thickness of strata have been removed over the whole area, leaving the plateau still from seven thousand to eight thousand feet high; and lastly, into this plateau, a cañon-cutting from three thousand to six thousand feet deep. The general erosion has given rise to a series of cliffs from a thousand to two thousand feet high, and extending for hundreds of miles; while the elevation, especially in its later stages, has broken the earth-crust into parallel oblong blocks from twenty to thirty miles wide and a hundred or more miles long, which, by settling unequally, have produced vertical displacements of a thousand to six thousand feet. These displacements, having occurred in comparatively recent times, have not yet been obliterated by erosion, and therefore still exist as cliffs. Thus, besides the east and west erosion-cliffs, there are also north and south displacement-cliffs: these latter pass by insensible gradations into monoclinical bends of the strata. As soon as the region became land, of course a river-system was established. As the region rose, the rivers cut down *pari passu*, and thus maintained their positions. The Grand Cañon itself, into which the tributaries drain, is in the axis of the elevation. Thus it has come to pass that the rivers run against the inclination of the strata, cutting deeper as the strata rise, southward. This remarkable persistence of river-beds, in spite of great orographic changes, was first pointed out by Powell.

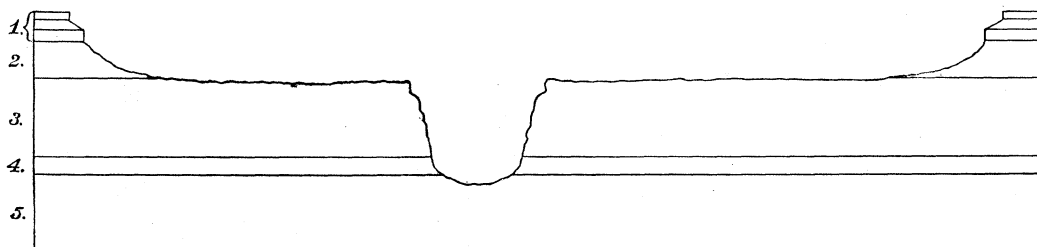
The time when these different events occurred has been accurately determined by Dutton. In eocene times, nearly the whole plateau region was covered by the waters of a vast lake, in which many thousand feet of strata were deposited, — the same which yielded such treasures of mammalian remains to Marsh and

Cope. At the end of the eocene, this lake was drained by elevation, the present river-system was established, and the general erosion commenced. It is probable, that, during the miocene, the climate was moist, the rain excessive, and the general erosion very great. Most of the general erosion was done during this time. During the pliocene the elevation was greatly increased, the climate became dry,

certainly in this Capt. Dutton excels. We would especially draw attention to his really magnificent description of the towers of Vermilion Cliffs (p. 86), of the temples and towers of Virgen River (p. 88), and his ride on Kaibab plateau to Grand Cañon (p. 136).

It is needless to say that the memoir is illustrated in a manner worthy of the subject.

It is already well known, through the previous



and, while a moderate general erosion continued, the stream-cutting became excessive. The upper, outer, and greater part of the Grand Cañon was made at this time (see the accompanying figure). Toward the end of the pliocene, things settled for a while: the streams reached a base-level, and cut no deeper for a long time. At the beginning of the quaternary, a somewhat rapid rising again began, and has continued to the present time. This last rising inaugurated the cutting of the inner cañon. The comparatively rapid rising of the pliocene and quaternary times produced the north and south faults, and, in connection with these, igneous outbursts on a grand scale.

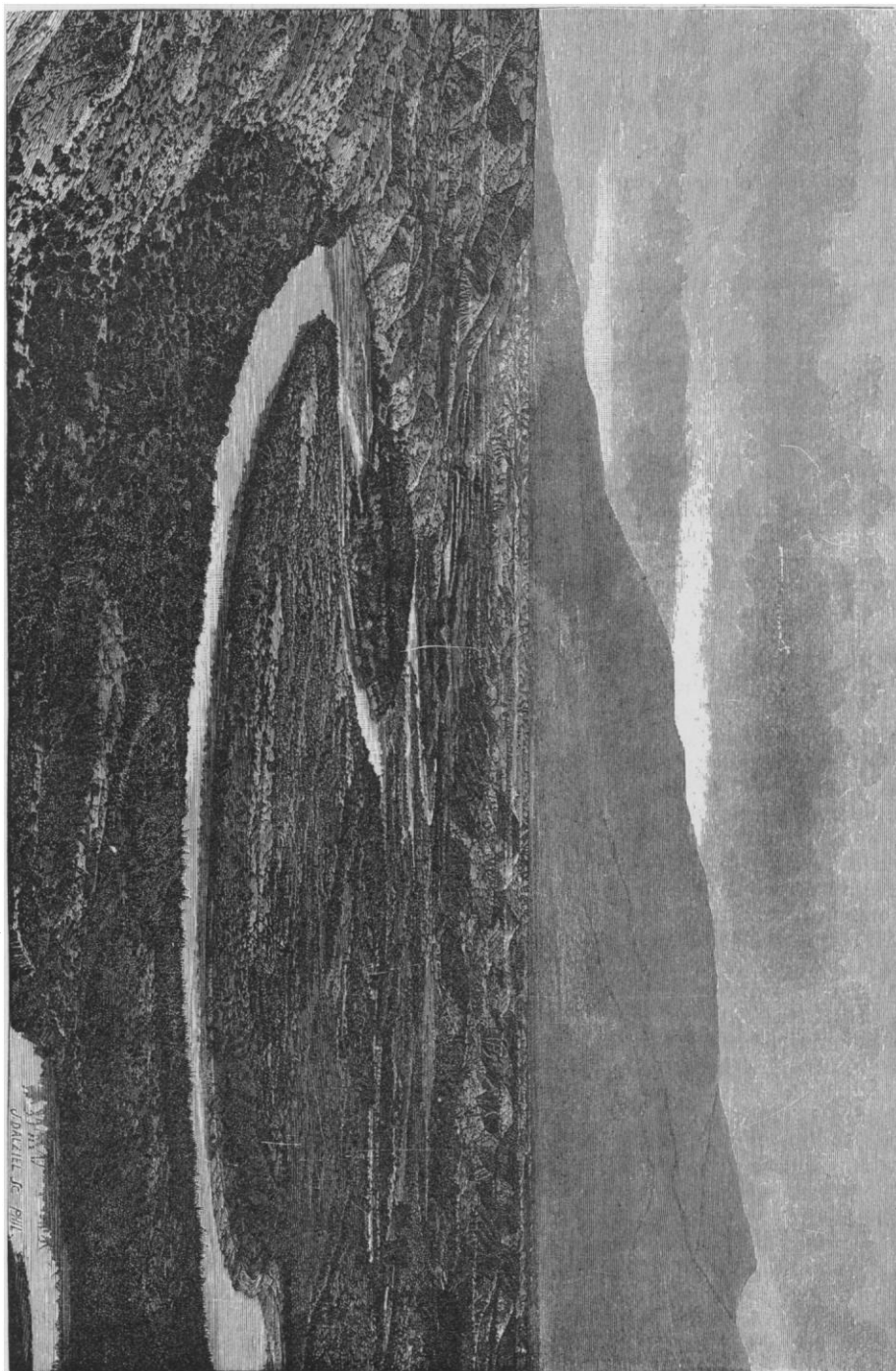
Although the author does not, *we* would correlate this last elevation and its outbursts with the elevation and lava-flows which took place in California at the beginning of the quaternary, and the inner cañon of the Colorado with the deep cañons of the present river-systems of that state. In middle California the pliocene rivers were displaced by the lava-flows, and therefore had to cut new beds. These were cut much deeper than the old, because the country was greatly elevated at that time. But in southern California the country was elevated, but the rivers were not displaced: therefore, like the Colorado, they cut in the same place, but deeper; and remnants of the old beds are now found on the flanks of the present cañons.

Capt. Dutton has sometimes been criticised for a style unbecoming a scientific treatise. We do not agree with these critics. Nothing short of vivid word-painting can give any adequate idea of the peculiar scenery; and

labors of Gilbert and King, that in quaternary times the basin region was largely occupied by two great lakes, separated by the East Humboldt Range. The one occupying Utah basin, of which Great Salt Lake, Utah, Bear, and Sevier Lakes are the residues, was named by Gilbert, Lake Bonneville; while that occupying Nevada basin, and of which Pyramid, Winnemucca, Carson, Humboldt, and Walker Lakes are the residues, was named by Mr. King, Lake Lahontan. The complete study of these lakes has been undertaken by Mr. Gilbert and Mr. Russell. The great importance of this investigation lies in the fact that lakes without outlets are the clearest indicators of changing climate. We can only touch lightly the most important results, referring the reader to the memoir for the proofs.

According to King, in early pliocene a great lake, which he calls Lake Shoshone, covered nearly the whole basin region. This lake seems to have dried away almost completely by the end of the pliocene. At this point Gilbert takes up the history of the region. At the end of the pliocene, Utah basin had a dry climate and a small residuary lake, as at present. During the quaternary, the lake rose until it reached a level nine hundred feet above the present, but did not find an outlet. Then it dried away gradually and probably completely, and its residual salt was buried beneath fine clay, or 'playa deposits' of Mr. Russell. This was followed by a second rising, which reached still higher, and the lake found an outlet into the Snake River. The lake was therefore fresh. The outlet stream cut its way down three hundred feet or more, until, finding a hard limestone, the

LAHONTAN LAKE-BEDS IN HUMBOLDT VALLEY.



lake stood at the six hundred foot level a long time, making a very distinct terrace (Provo terrace). Then by change of climate it lost its outlet, and dried away to its present condition. Mr. Gilbert correlates these changes with the first glacial, the inter-glacial, the second glacial, and the post-glacial periods. Other very important facts brought out by Mr. Gilbert are those connected with recent orographic movements. The floor of Utah basin has recently moved, and is probably still moving. The movement is unequal. The floor is *warping*. The great fault on the west side of the Wahsatch has recently slipped, and will probably again slip. The Wahsatch Range has grown very recently, and is probably still growing. Such slips produce earthquakes. The great Inyo earthquake of 1872 was produced by a slipping of the great fault on the east side of the Sierra, as was first pointed out by LeConte.¹

Mr. Russell's studies of Lake Lahontan entirely confirm the conclusions of Mr. Gilbert as to climatic changes. This lake also increased from mere residues to a level of five hundred feet above Pyramid Lake. Its shells show that it was at this time fresh; then it dried away completely, burying its salts, if any, beneath playa deposits. Then it rose again to the five hundred and thirty foot level (it was then also fresh); it again dried away to the present residues. Its terraces are traceable all around: it never found an outlet.

Mr. Russell continues the observations, commenced by King, on the remarkable deposits of this ancient lake. He divides these deposits into three kinds, which were made at different stages of the lake. In its first great rise, it deposited a hard, smooth, incrusting lime carbonate (lithoid deposit). At the one hundred foot level and downwards, it deposited what Mr. King calls thinolite, and which he regards as a pseudomorph after gaylussite. In the last and greatest rise, it deposited the dendritic tufa. Mr. Russell calls attention to the fact, that, if thinolite be a pseudomorph after gaylussite, it is difficult to understand what became of the enormous quantity of soda; for the lake never found an outlet. This problem is yet unsolved.

It is seen, then, that Lake Lahontan, like Lake Bonneville, shows two wet periods separated by a dry period, and probably two glacial periods separated by an interglacial period. Evidences of recent orographic movements are noted here also. Nearly all the basin ranges are formed by the tilting of long north and south

crust-blocks, each block being dropped on one side, and lifted on the other. The faults thus produced have been slipped very recently, and are probably still slipping. The mountains are still growing.

The three memoirs — of Emmons on the geology of Leadville, of Becker on the Comstock lode, and of Irving on the copper-bearing rocks of Lake Superior — all throw light on the genesis of ore-deposits.

In Mr. Emmons's admirable memoir we have a clear scientific account (the first ever given) of the wonderful argentiferous lead-deposits of Leadville. In this region the mountain system separating the plains from the plateau region consists of three ranges; viz., the Colorado, the Park, and the Sawatch. The first two are separated by the Parks; the last two, by the valley of the Arkansas River. The Park Range, in the vicinity of Leadville, is called the Mosquito Range. On the western slope of the Mosquito Range, or eastern side of Arkansas valley, is situated Leadville. The Mosquito Range consists of crumpled and faulted strata, from the Cambrian to carboniferous inclusive. The ore-deposits are in the carboniferous. Between the carboniferous strata are thick intercalary beds of porphyry, which have been forced between the separated strata without appearing on the surface. This irruption took place during the cretaceous. The whole series, both sedimentary and intercalary-igneous, was then folded and faulted. The mode of occurrence of the ore shows conclusively that it was deposited from solution in percolating water. The ore occurs in a gangue of oxides of iron and manganese, mixed with clay, in cavities and channels in the limestone. The limestone was dissolved and the ore substituted by the same water, the clay being the residuum of the dissolved limestone. The ore was originally disseminated in the porphyry, and thence leached out, and carried downward into the limestone. The original form was sulphides; but in many cases this has been subsequently changed into carbonates, chlorides, etc. It is seen, then, that these are not true fissure-veins, but deposits in irregular water-channels somewhat like the lead ores of Illinois, and like these latter, also, they occur in carboniferous limestone.

These important conclusions of Mr. Emmons in regard to the genesis of ore-deposits are substantially confirmed by Mr. Becker's study of the Comstock lode. This grandest of all lodes is, however, a true fissure-vein. We note only the most important conclusions of this careful memoir.

¹ *Amer. Journ. sc.*, vol. xvi. p. 101, 1878.

The vein is at contact of a diabase country on the one side, with a diorite on the other. Mr. Becker finds evidences of repeated slipping. Below, it probably cuts into the diorite. The ore was derived from the eastern diabase country, in the augite of which, analysis still finds the metals in small quantities. The disseminated metals were leached out and carried westward into the fissure, and there accumulated. The solvent water was hot, and contained alkaline carbonates and alkaline sulphides; in other words, was solfataric. The rocks were left in a widely decomposed condition. These conclusions are confirmed by the observations of others, as well as of Mr. Becker himself, on the phenomena of deposit of silica and metallic sulphides from solfataric waters, now going on at Sulphur Bank and Steamboat Springs. It is not unlikely that the process is still going on also in Comstock lode.

On several points Mr. Becker differs from previous observers. Richthofen, in his celebrated memoir on A natural system of igneous rocks, gives a prominent place as a rock species to propylite. Mr. Becker thinks, and probably rightly, that propylite is only an altered andesite, and therefore that the species is untenable. Rosenbusch, however, had already shown that propylite must be regarded as a modification of andesite, and Mr. Becker ought to have stated this fact.

Again Mr. Becker differs (and we think again rightly) from Church as to the source of the heat of Comstock lode. Church ascribed it to kaolinization. Mr. Becker shows the insufficiency of this cause, and suggests as a more probable cause solfataric action, the feeble remnant of previous volcanism.

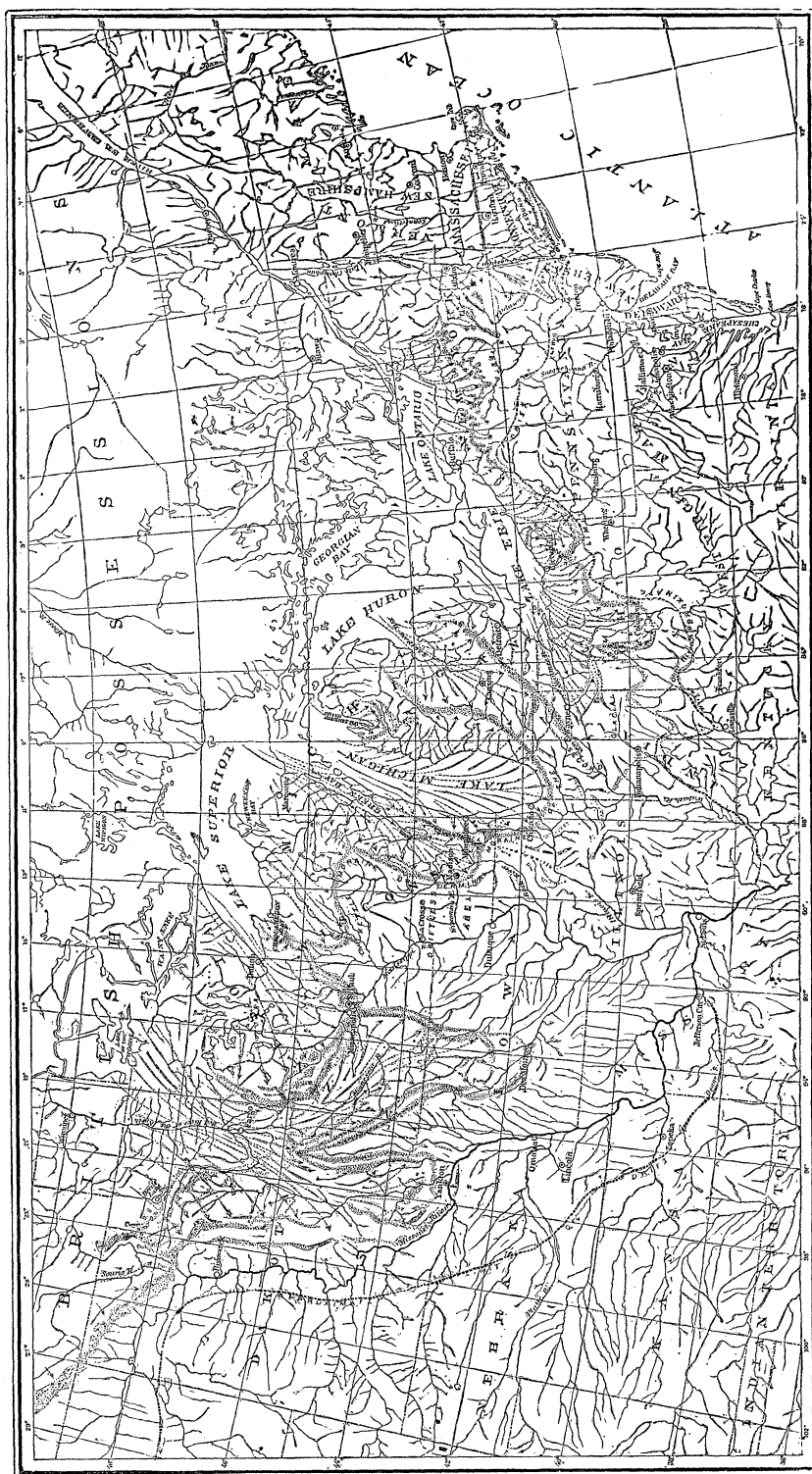
The memoir of Mr. Irving on the copper-bearing rocks of Lake Superior deals with some of the most vexed questions in geology. When such men as Hunt, Whitney, Selwyn, Wadsworth, and Irving differ as to the age and stratigraphic relations of the copper-bearing series, those who have not personally examined the ground have no right to an opinion. Mr. Irving's view is, that this series partly fills the great gap between the Huronian and the Cambrian. It consists of sandstones and conglomerates, with interbedded sheets of igneous rocks, mostly basic; the whole being of enormous thickness.

As to the mode of occurrence and origin of the ore, there is a resemblance to, yet striking difference from, that of Leadville. As in Leadville, so here, we have alternating sheets of strata and lava; also, in both, the ore seems

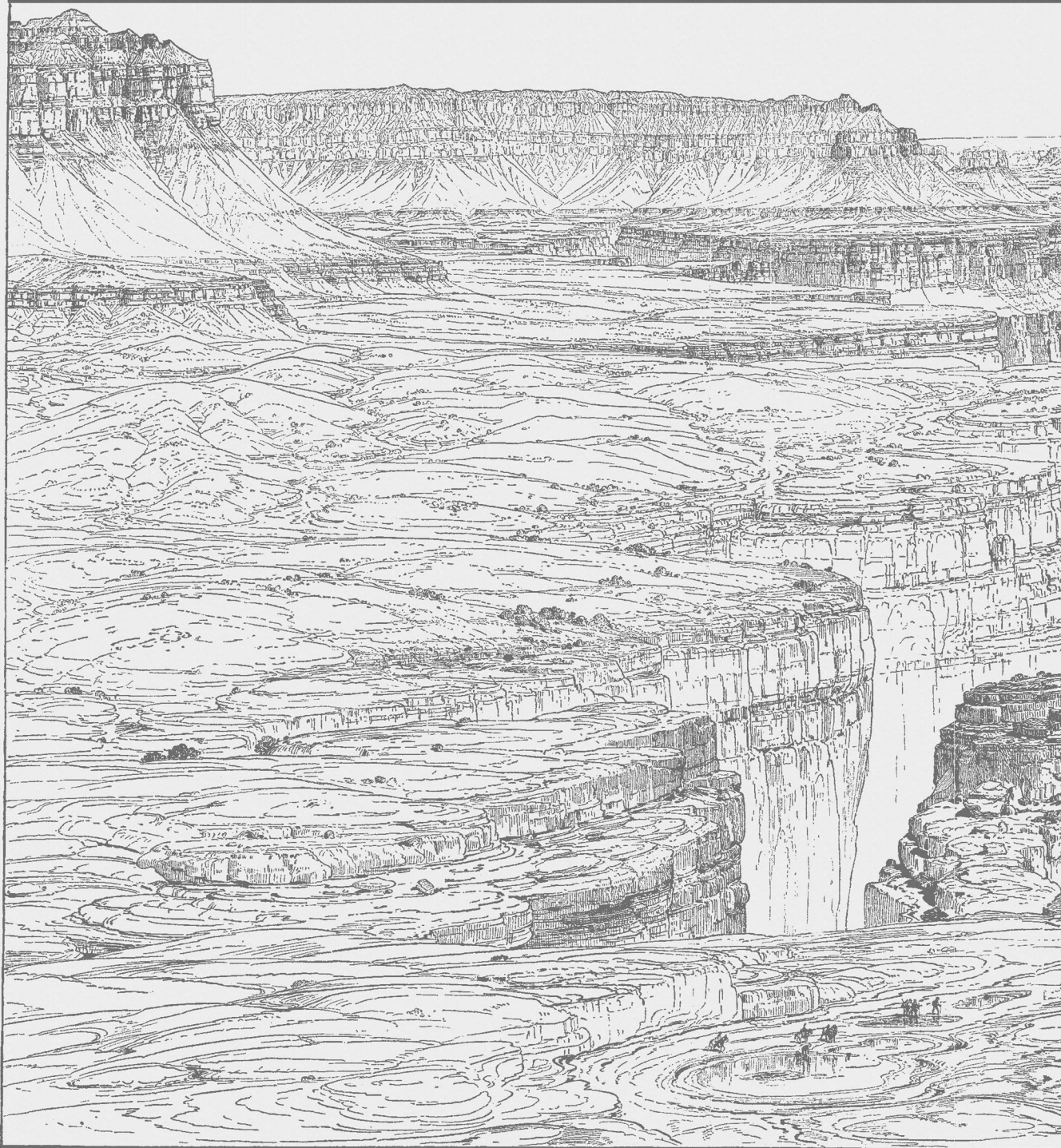
to have been leached from the igneous, and gathered in fissures, cavities, water-channels of any kind in the intervening strata, by means of down-percolating water; also, in both, the deposit seems to have been made by substitution; although the explanation of the substitution is more difficult in this case. But, on the other hand, the age of the strata is pre-Cambrian instead of carboniferous; the strata are conglomerates and sandstones instead of limestones; and the intercalary beds are contemporaneous instead of subsequent, i.e., poured out on the surface, and covered with sediments, instead of forced between the strata. As to the obscure question of the reactions by which ore was deposited, the author seems to adopt Pumphelly's view, that the copper was carried in solution as sulphate, and was reduced by the iron of the basic rocks, which oxidized itself at the expense of the copper sulphate.

The memoir of Hague on the Eureka district does not touch the mines of this district: that is left for a future memoir. It is confined wholly to descriptive geology. As such, although not entertaining popular reading, it is a model of painstaking, conscientious work. It is on such work, and such only, that a true geological science must be built. Only one point we have time to notice. Mr. Hague declares that there is no trachyte at all among the western eruptive, what has gone under that name being andesite. This decision is founded on the fact that plagioclase is the dominant felspar in all of them. The fact admitted, the decision seems well founded. But surely some consensus of view as to the basis of classification of eruptive is devoutly to be wished for. Shall it be the look and habit, or mode of occurrence, or mineral constitution, or age, or all these together? When shall order come out of this chaos?

It is a pity that Mr. Chamberlin's paper on the second glacial moraine comes last among the geological articles; for we are pressed for room, and the subject is to us a specially inviting one. The author commences his work by trying to remove the confusion which exists on the subject of drift-deposits. He makes three kinds of till: viz., 1, subglacial or true till; 2, englacial or superglacial till (a looser top material); 3, subaqueous till, often confounded with the first, but deposited by floating ice. He also distinguishes between osars and kames. After many other distinctions which deserve studious attention, he describes the peculiar structure and appearance of terminal moraines, and then applies these principles to the identification and tracing of the second glacial, or



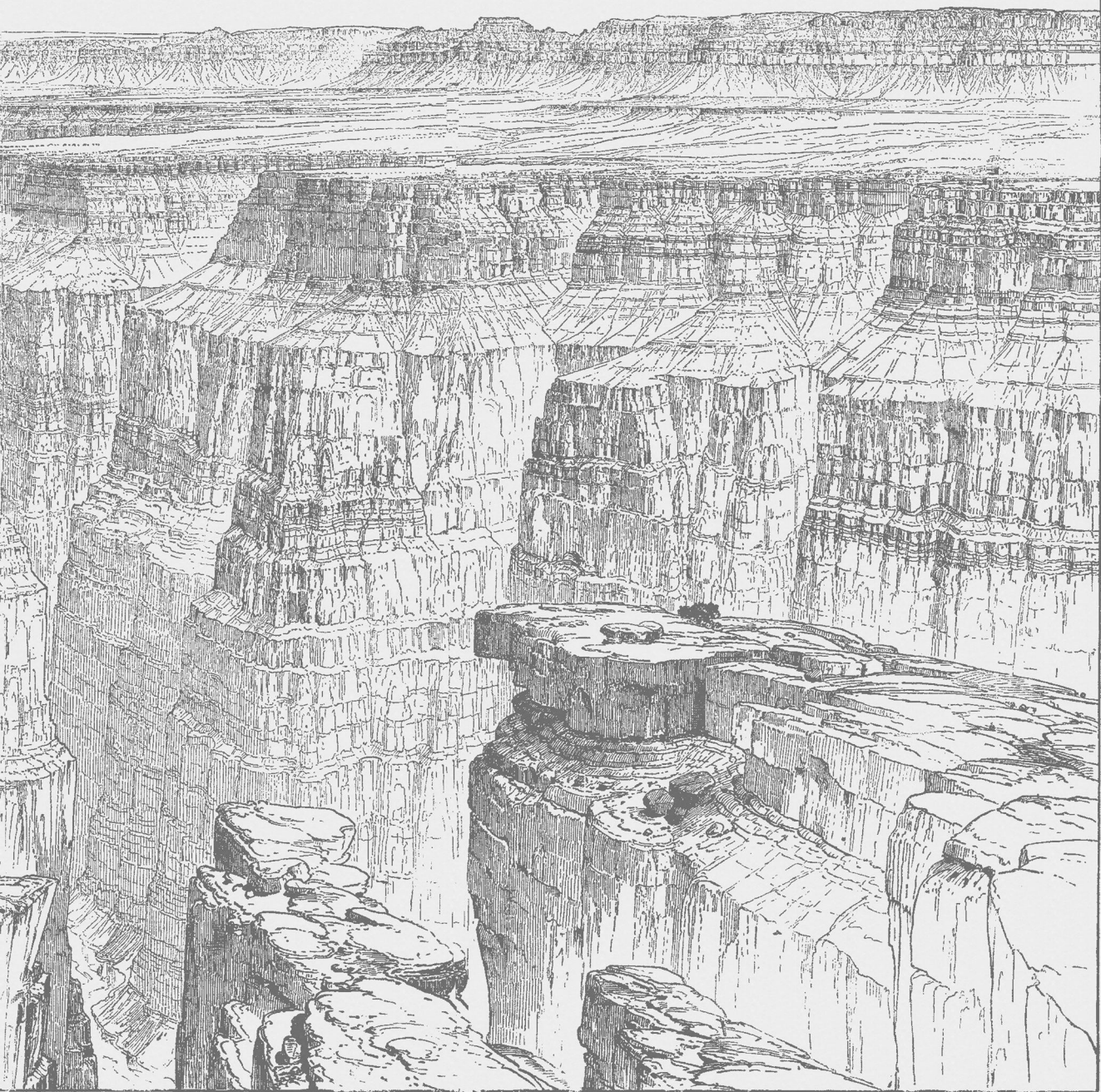
GENERAL MAP OF THE TERMINAL MORaine OF THE SECOND GLACIAL EPOCH.



THE GRAND CAÑON AT THE



THE GRAND CAÑON AT THE FOOT OF THE TOROWEAP, LOOKING EAST



THE TOROWEAP, LOOKING EAST.

so-called 'kettle' moraine. As is well known, chiefly through the work of the author, together with Upham and others, this moraine consists of a series of loops about the Great Lakes, and continuing thence eastward and westward. Commencing with the Green-Bay loop as most typical, the author describes every loop separately and minutely, taking them in succession going eastward, and then returning and going westward. All we can do here is to trace briefly the course of this moraine as shown in the map, plate xxviii.

Commencing eastward, this moraine passes through Cape Cod and through Long Island, to New York. This part is often described as the first glacial or *limit moraine*. If so, the two are here coincident. But possibly the true limit is farther out to sea; or, more probably, the ice-sheet at its farthest limit ran out here into the sea, and formed no moraine at all, its *débris* being carried away by icebergs. From New York the two moraines separate, the limit moraine passing through New Jersey and Pennsylvania, where it has been traced by Cook and Lewis; while the second glacial moraine turns northward into middle New York, passes in a curve around the Finger Lakes, and then southward to join the limit moraine in eastern Ohio. After running together a little way, they again part company, the limit moraine passing along an irregular line a little north of the Ohio River, then crossing the Mississippi and following the south and west side of the Missouri River into Montana and British America; while the second moraine turns northward, sweeps about the Great Lakes in a succession of loops, and then, making two more grand loops, — one in Iowa and one in Dakota, — it finally passes along the Coteau of the Missouri, and onward into British America.

The importance of the work of Mr. Chamberlin and Mr. Upham, in connection with that of Messrs. Cook, Lewis, and Wright, on the first glacial or limit moraine, in their bearing on the question of the existence of a veritable ice-sheet, cannot be overestimated.

In the paper on barometric measurements by Mr. Gilbert, a new method of measuring heights is brought forward. The essentials of this method are as follows:—

For the purposes of observation there are two base stations, one high and one low, the difference in altitude between them being as great as possible, compatible with close verticality. At these two stations, only the barometer and its attached thermometer are observed, no other instrument being considered necessary. The actual difference in altitude be-

tween these base stations is determined by spirit-level; and this constitutes the altitude, — a vertical base-line, by which all other altitudes are gauged.

The field-notes consist of barometric readings applying to the upper base station, the lower base station, and the new station, respectively.

The method of computation consists in first correcting the instrumental readings for index-error and temperature. These readings are then collected in groups of three, each observation at a new station being associated with the coincident observations at the base stations. The altitude of the upper base station is then computed as usual, without applying the corrections for moisture, temperature, or gravity; and the height of the new station above the lower base station is calculated in the same way, thus assuming that the air is dry, and has a uniform temperature of 32° F.; and, these two results being considered approximate, the following proportion is made:—

Approximate height of base-line : True height of base-line ::
Approximate height of new station : True height of new station.

There is little of importance in this publication that has not appeared previously in some form or other.

Of course, the method would, in the first place, be limited in its application to a very small horizontal area; for only in such an area could the conditions of density be similar enough to allow of its use: and the first thought that would strike one would be the comparatively rare occurrence of the conditions of verticality proposed, though the method certainly has the mark and merit of ingenuity.

Most of such devices are designed to do away with the influence of the 'hour of the day,' as it is called, or the varying effect of the different conditions of temperature and moisture. Any real control over these elements in the problem must come from the careful noting of all the circumstances under which the data are collected; and the question can only be decided, if it ever is, by observations continued for a long time.

The only great effort to secure the data for this 'horary' correction was made by Plantamour, in his discussion of the forty-year series of observations carried on between Geneva and the St. Bernard hospice:¹ but this series only covers one of the many conditions under which such measurements may be made, for decided differences would be introduced by unequal insolation along mountain chains, near

¹ Mém. Soc. phys. Genève.

plateaus (whether high or low), on the coast, or in different seasons; and it would seem from these records that the only means of obliterating the effect of these temporary disturbances is in having a large number of observations made, and taking their average.

This would also seem to throw some doubt upon the value of Williamson's method of obtaining this correction from the curve of the day: for days differ so much that a large arbitrary or constructive element would be introduced, thereby damaging the results as far as scientific accuracy is concerned; for we can easily see that the difference between a clear, bright day, and a day in which the sky might be wholly or partly covered, would be great, and therefore much would be left to the judgment of the observer with regard to applying the whole or only a part of any correction which might be obtained for use in such cases:¹ for, at best, we only get a sort of skeleton average from the mathematical formulæ; and it is quite certain that the formula of Laplace gives too high results for general use, since it is only adapted for the summer months.

The second objection to this method, therefore, would seem to be found in the comparatively arbitrary use of the data obtained.

If we could only obtain a partial solution of this problem by securing a portion of the proper correction, it would be a great gain.

The temperature correction would not, perhaps, be so difficult to obtain; but, when we once introduce the element of moisture, we perceive that the uncertainty of controlling the conditions increases, except by having full averages of all the elements involved, as their variability is so great.

One has only to look into the work of Planamour to become convinced of this; and the results obtained from these records, as worked out by Dr. Guyot, show it conclusively.

It has therefore been Dr. Guyot's principle to simplify the methods, both of observation and of computation, as much as possible, so as to facilitate the making of a large number of observations, and from their averages obtaining better results. By this means the original records are touched as little as possible; and the results are sufficiently accurate for the purposes of the geographer.

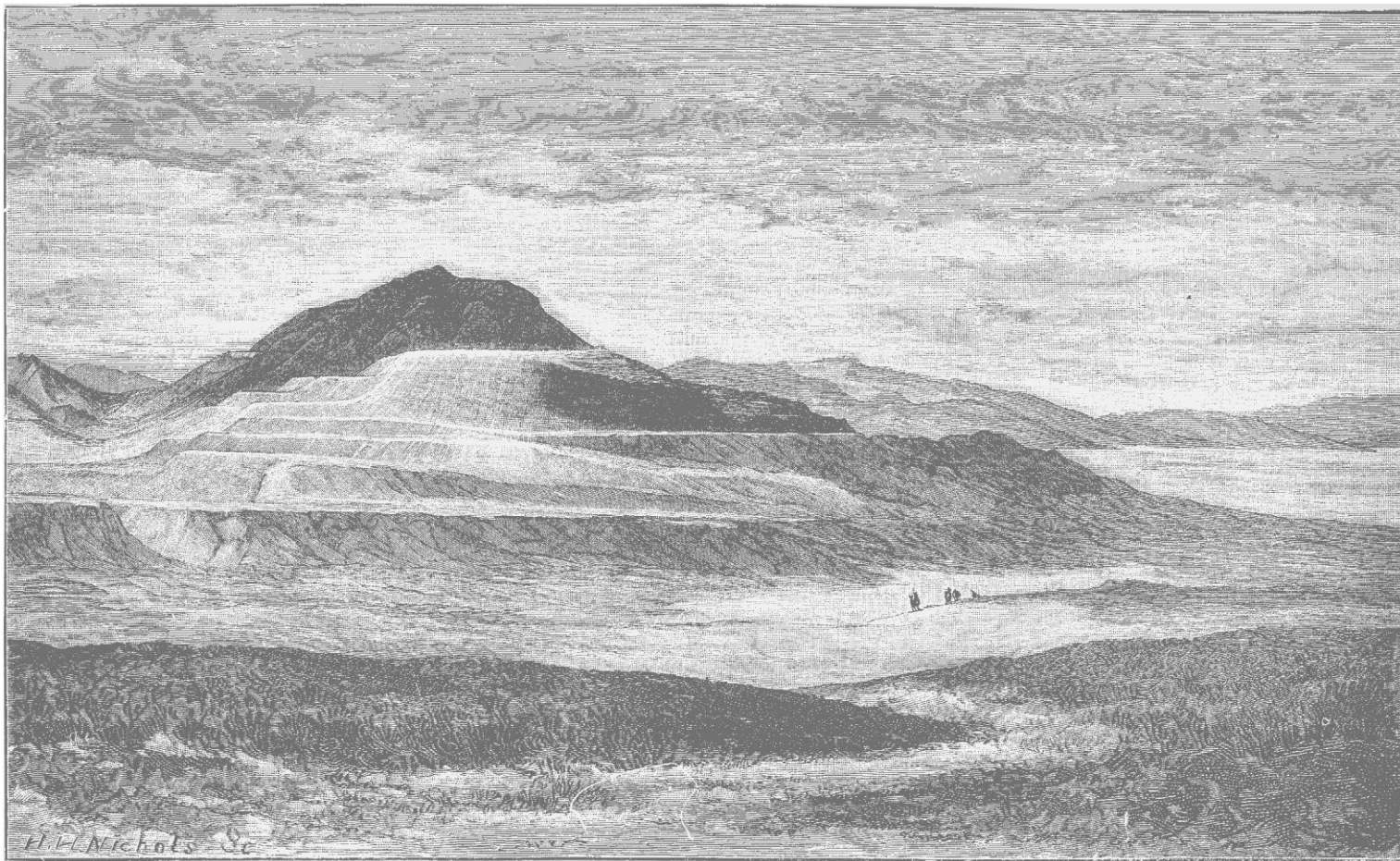
The trouble is, that these difficulties arise from the nature of the problem; and it is very doubtful whether they will ever be completely mastered.

There is another objection to the proposed method, which would seem vital; and that is,

that it materially increases the cost of such a survey, not only by the employment of an additional observer, but also by making the measurement of a number of vertical baselines by level a necessity in an extended survey; and any thing which does this, thereby bringing the expenses nearer to the amount necessary for a regular levelling-survey without proportionally increasing the accuracy of the results obtained (for the liability to errors of observation and computation is greater), is at least of questionable advantage.

In his 'Non-marine fossil Mollusca,' Dr. C. A. White presents a valuable review of the North-American brackish, fresh-water, and land Mollusca, beginning with their first representatives in the Devonian, and tracing the history of many cases of persistence to modern forms. Every paleontologist has to contend with large gaps in material; and these are more extensive among the inland than among the marine Mollusca. Another difficulty lies in distinguishing between the brackish and fresh and salt water forms. These are often commingled, especially in the Laramie rocks, which bear evidences of frequent littoral changes in the estuaries and inland seas. Following a geological introduction, the author presents an elaborate historical catalogue of the genera of the Conchifera and Gasteropoda. There is a happy omission of any attempt at revision of species (an endless task), and little technical description; while more attention than usual is given to the interesting question of changes of habitat during successive periods, and relationships with other fossil and modern forms. A curious fact, which has so many parallels among the other Mollusca, is the early appearance and development of the pulmonate gasteropods, which are found as low as any of the Conchifera. With the necessary presumption of the derivation of the non-marine from the marine types, the author infers that this has taken place not only in paleozoic, but in more recent geological times. The marine types, having suffered the fewest changes of environment, have been the most persistent; then rank the land and brackish-water types; but, in view of the continual changes in the fresh-water areas, the persistence, even to the present day, of several fresh-water forms, is most remarkable. According to the author, the latter forms abounded in the great tertiary lakes: they survived the contraction of the lakes into the great river-systems, and they owe their wide dispersal to the confluence of these river-systems, as in the case of the Ohio and Mississippi, which originally poured into the Gulf. It appears that

¹ Bulletin No. 2, E. M. museum of geology and archaeology.



RESERVOIR BUTTE, SHOWING TERRACES OF THE BONNEVILLE SHORE-LINES.

areas of extinction have been areas where the old river-courses have changed or dried up; and these, according to Powell and Dutton, are comparatively few. An interesting line of research suggests itself here, which lack of material may prevent at present, upon the divergence of structural characters after the separation of the eastern and western fauna by the Rocky-Mountain system.

Professor Marsh's paper upon birds with teeth contains little that did not appear in his monograph, 'Odontornithes:' it is, in fact,

an abstract of that volume, with the omission of many details of structure. There have been added, however, several characters to *Archaeopteryx*, which the author himself discovered upon the European specimens. It is an astonishing fact, worth mentioning here, that in many foreign museums it is still considered more important to preserve these specimens intact than to publish the rich truths they might reveal under a careful use of the hammer and chisel.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Rocks from Oregon.—During the field-season of 1883, Mr. Frank Wood, a stone-cutter in Albany, Or., contributed to the Cascade-Range collection of rocks several specimens of stone used extensively in that part of the country for building and ornamental purposes. They were examined by Mr. J. S. Diller, and proved to be of unusual interest, not only on account of their economic value, but also for their bearing upon the geological history of the Cascade Range.

Among them was an eruptive rock, which is quarried twenty miles east of Albany, on the western slope of the Cascade Range, and which presents an ancient aspect. The composition of this rock is that of a diabase with an admixture of rhombic pyroxene; but in its general facies and structure, as well as in the character of its alteration products, it is closely related to the gabbros. Rocks of the same character, high up in the mountains, are abundant a short distance south-west of Mount Hood. While it has long been known that the Cascade Range is built up chiefly of recent lavas, it is becoming more and more evident that eruptions of gabbroic and granitic rocks must be admitted as important elements in its construction.

On the Willamette River, eight miles from Albany, a sandstone is quarried which belongs to the tertiaries of the Willamette valley, and, with the exception of the cementing-material, is composed wholly of volcanic matter. When first taken from the quarry, it is said to be soft, and easily carved into any desired shape. Upon exposure, it becomes hard and more durable. This change in its physical character, so far as can be judged from the hand specimen in the collection, appears to be connected with a peculiar alteration in its cement. The unaltered sandstone, when held in such a position as to reflect the light from its surface, is seen to have a peculiar shimmer, which, upon closer examination, is found to come from the brilliant cleavage-surfaces of the well-crystallized calcite which forms the cement. The

rock splits quite readily in three directions. Following these lines of easiest cleavage, a small rhombohedron was split out of the sandstone, which showed the peculiar shimmer on all sides. With an improvised goniometer, the angles between the reflecting surfaces were measured, and found to be the regular cleavage-angles of calcite. In the thin section it could readily be seen that the calcite cement had the same optical orientation throughout. There can be no doubt that all the calcitic cement within the hand specimen belonged essentially to the same crystal. Professor Irving has shown that siliceous cement in sandstone is very frequently arranged with reference to the crystallographic axes of the quartz-grains which it envelops. It is much less common, however, to find the cement arranged as in this Albany sandstone. That carbonate of lime can arrange itself in one crystal, when mixed with from fifty to sixty per cent of sand, is clearly shown by the well-known crystals from Fontainebleau and Nemours, in France. Under atmospheric influences, the calcitic cement appears to be replaced by one which is in large part siliceous. The boundaries of the grains of sand become less distinct, and the cement assumes a spherulitic structure. To be able to assert positively that this peculiar structure in the cement of a sedimentary rock is due to weathering, our observations with the microscope need to be supplemented by an examination of the rock *in situ* at the quarry. The rock, therefore, becomes more durable, being insoluble, and is much less liable to injury from great and sudden changes of temperature.

Krakatoa dust.—A report by Mr. Diller, on the Krakatoa dust submitted to him for examination, has been completed. Reusch determined the rhombic pyroxene in the Krakatoa dust to be bronzite, while Daubree, Renard, and others have asserted that it is hypersthene. Although Mr. Diller obtained the dust from four different localities, enough was not received to furnish sufficient rhombic pyroxene for chemical analysis to settle the question; and without a Nörrenbergs apparatus, or a microscope with a larger field than the one used by Mr. Diller for the observation of optic axial figures, so that the char-

stomach. These are formed of delicate membrane, lined by a layer of secreting-cells so arranged that a central channel is left for the transmission of the bile. The cells are polygonal from mutual pressure, nucleated and nucleolated, often projecting, and giving the tubes a beaded aspect. The bile is apparently composed of oil-globules and many fine dark granules. The entire organ is very tortuous, and closely applied to the alimentary canal.

Minnesota academy of natural sciences.

June 3. — Mr. C. L. Herrick described *Spirochona gemmipara* Ehr., — an infusorian found parasitic upon the gills, legs, and gill-covers of *Gammarus lymnaeus*, near the university grounds. The European *Spirochona* was the subject of an elaborate memoir by Hertwig, and was shown to be one of the most pleasing subjects for the study of the subdivision of the nucleus. Attention was drawn to the fact that the American species of *Spirochona* seems beyond a doubt identical with the European, while the *Gammarus*, upon which it lives, is of a different species from that forming its host in Europe. It was not found upon *Hyallolella* or elsewhere. *Spirochona Scheutenii* Stein is the only other member of the genus, and may not be distinct. — Mr. Herrick also mentioned the occurrence of another curious protozoan in Minnesota, this form being similar to *Ophridium versatile* of Ehrenberg. The animal bearing this name is allied to the *Vorticellae*, and is social; but the colonies adhere to the surface of crystal-clear masses of jelly, which may be as large as one's fist. The individuals are sessile upon the sphere, and are peculiar in the great length of the neck-like anterior part of the body when extended. The American specimen measured 0.16 of a millimetre when quite extended. The width of the peristome is .024 of a millimetre. The species was provisionally called *Ophridium problematicum*. A third infusorian was described as closely related with *Paramoecium*, but differing in several interesting particulars from it and its allies. In form, this animal is linear lanceolate (about 0.2 of a millimetre long), tapering posteriorly to an almost acuminate point. Anteriorly is a long vibratile proboscis, or flagellum, which exceeds, when extended, the whole length of the body. The mouth is situated at the base of this proboscis, and opens into a very short infundibulum. The whole surface of the body and proboscis is covered with minute cilia, which are inserted in rows, giving the body a punctate appearance. Longer cilia surround the mouth. The sarcode is transparent, and, aside from a few greenish food-balls, contained only a large number (over a dozen) of oval bodies of a similar character (endoplastules in an unobserved coiled endoplast?) The motions of the animal are very quick, and are occasioned chiefly by the whip-like motions of the proboscis, which is extremely vigorous in movement, and alters its form greatly. Aside from this rapid motion, it can propel itself slowly by means of the cilia covering the entire surface. It is the type of a new genus,

and was called *Phragelliorhynchus nasutus*. — Rev. L. J. Hange contributed a letter on the vegetable remains of the drift. As a missionary among the Scandinavians and Indians of the north-west for over a quarter of a century, his attention has been called frequently to these remains; and he has over seven hundred specimens of woods, leaves, etc., in his collection. In Minnesota, wood is found at from thirty-five to forty-five feet below the surface: going west into Dakota and Montana, the depth is greater. On the Missouri, above Bismarck, a stump twenty-three feet high and a foot in diameter was struck fifty-nine feet below the surface. Many pines have wood well preserved; others are completely silicified and chalcedonic. Upon many a high point of land in western Dakota one finds a pile of stones, and among them some fine specimens of the silicified wood peculiar to this region. These piles were evidently built by human hands; and the writer suggested that they were built by the Indians as altars or landmarks. — Rev. Dr. H. C. Hovey related some interesting facts touching the habits of the ant-lion, a colony of which he keeps in his study.

NOTES AND NEWS.

OVER one hundred members of the British association have notified the local committee at Philadelphia of their intention to be present at the meeting of the American association. About seven hundred of the British association are expected at the meeting in Montreal.

— *Nature* states that the arrangements for the meeting of the geological section of the British association are now well advanced.

The International geological congress meets at Berlin in September, and this will prevent many continental geologists from going to Montreal; Dr. Richthofen, however, will probably be present, and will communicate a paper on some comparisons between the geology of China and North America. It is hoped that others may also arrange to come.

Meeting in the typical Laurentian country, it is only to be expected that the archæan rocks will receive much attention. Amongst the papers sent or promised are the following: Professor Bonney, on the lithological characters of the archæan rocks in Canada and elsewhere; Mr. Frank Adams, on the occurrence of the Norwegian 'apatitbringer' in Canada, with a few notes on the microscopic characters of some Laurentian amphibolites; Dr. T. Sterry Hunt, on the eozoic rocks of North America.

On paleozoic geology and paleontology generally, the following are expected: L. W. Bailey, on the Acadian basin in American geology; E. W. Claypole, the oldest known vertebrates, — an account of some fossils recently discovered in the Silurian rocks of Pennsylvania; J. H. Panton of Winnipeg, geological gleanings from the outcrops of Silurian strata in the Red-River valley, Manitoba. Principal Dawson will give a comparison of the paleozoic floras of North America and Europe, whilst Mr. J. S. Gardner will

deal with the same subject as regards the cretaceous-tertiary floras. Other papers are: G. F. Matthews, on the geological age of the Acadian fauna, and on the primitive conocoryphean; E. Wethered, the structure of English and American coals.

After the azoic and paleozoic rocks of Canada, the drift-deposits are of great interest. The following papers bear on this subject: Mr. A. R. C. Selwyn, on a theory of ice-action in the formation of lake-basins and in the distribution of bowlders in northern latitudes; the Rev. E. Hill, on theories of glaciation; F. Drew, on the thickness of ice in the Himalayan valleys during the glacial period.

Amongst other papers of interest are: Professor Hull (who is not expected to be present), on the geology of Palestine, giving an account of his recent explorations; Prof. T. R. Jones, on the geology of South Africa; W. Whitaker, on the economic value of geological maps, with especial reference to water-supply, illustrated by the survey maps of the chalk area in England. Papers are also promised by Dr. Arch. Geikie, Dr. G. M. Dawson, Prof. V. Ball, Prof. W. Boyd Dawkins, Dr. C. Le Neve Foster, W. Carruthers, H. Bauerman, E. Gilpin of Halifax, N.S., and others.

Several reports will be submitted by committees, or by persons appointed for this purpose at the last meeting of the association (the name mentioned is that of the secretary to the committee, or the reporter): Prof. J. Milne, earthquakes in Japan; W. Cash, fossil plants of Halifax; G. R. Vine, British fossil Polyzoa; Dr. H. W. Crosskey, erratic blocks of England, Wales, and Ireland; Prof. T. R. Jones, fossil Phyllopoda of the paleozoic rocks; C. E. De Rance, underground waters; J. W. Davis, Raygill fissure, Yorkshire; C. E. De Rance and W. Topley, erosion of seacoasts of England and Wales; F. Drew and Prof. A. H. Green, the present state of knowledge respecting the interior of the earth; W. Whitaker, geological record; W. Topley, national geological surveys, and progress of the international geological map of Europe.

The local committee at Montreal is preparing a guide-book to the city and neighborhood, which will contain a geological map. A general geological guide to the dominion will be prepared by the geological survey of Canada.

— We regret to learn, that, at the close of the first year, Williams college relinquished the only American table held at the Naples zoological station. It was occupied in the first part of the year by Dr. E. B. Wilson, and, in the latter half, by Prof. S. F. Clarke of the college; who, however, was taken ill soon after reaching Naples, and is not yet fully recovered. Only one applicant for the table appeared for the second year.

— Raoul Pictet writes to the *Journal de Genève* of his first acquaintance with Wurtz, as follows:—

“It was in 1867. I reached Paris with a letter of introduction from Mr. A. de la Rive, I entered the court-yard of the medical school, where was pointed out to me a square room quite poorly lighted, and

rather small for the twenty students who narrowly found place there. Mr. Wurtz, in laboratory costume, alert and active, was going from one to the other, and was talking with great animation. One of his favorite scholars was at this moment taking his examination for the fellowship, with what anxiety to know the result.

“I shall never forget the words which Mr. Wurtz with frank cordiality addressed to me: ‘You come from one of the masters of science; my laboratory is open to you; there are but twenty places; ah, well! this year there will be twenty-one of us.’ Then after having appointed me to a place, and introduced me to Mr. Wilm, his chief attendant, he added, ‘By the way, you know, I receive Friday evenings; you will always be welcome; this invitation I never repeat.’

“And in this way the students who were fortunate enough to be near the teacher found in him at the same time a learned professor, a director of their studies, an inspirer of their discussions, a defender of new but logical ideas, and a friendly adviser, an interesting and cheerful converser, a host at enjoyable and easy receptions, happy to please and to be useful to those whom he considered his intellectual family. How can I reproduce here the impression left by the scientific discussions excited in the laboratory by the work of a scholar or by a new discovery! There was an enthusiasm, an impulse, a joy, which we all felt under the direct and spontaneous influence of an instructing friend, a respected master.”

— The fifth international hygienic congress will be held at The Hague from the 21st to the 23d of August, under the presidency of the ministers J. Hemscherk and de Beaufort. The work of the congress will be divided into five sections, and lectures will be given from three to four o'clock every afternoon. The principal speakers will be L. Pasteur, on methods of infection; H. Paechiotti of Turin, on the hygiene of the future; Professor Finkelnburg of Bonn, on the influence of the microbe theory; Jules Rochard, on the value of public hygiene; Stephen Smith of New York, on the medical professions in the United States; E. J. Marey of Paris, on useful powers in the forward movement; W. H. Corfield of London, on science and sickness; E. Irélat of Paris, on hygiene in dwellings; J. Crocq of Brussels, on drinking-water. Other lectures will be given by Drs. Koch and Bockh of Berlin. Applications for participation in the congress should be addressed to Professor van Overbeck de Meijer of Utrecht.

— At a late session of the section of physical and experimental science of the Royal society, Mr. G. Johnstone Stoney, late astronomical assistant to the Earl of Rosse, described a form of instrument which had proved very successful in completing the optical adjustment of reflecting-telescopes. The new collimator which he invented as long ago as 1857 was made by Mr. Grubb last autumn, and is a short-focus telescope of two inches aperture and eleven inches long, which, when used, is to be inserted into the eyepiece-holder of the large reflector. A spark between

platinum points is produced in the focus of this instrument by a small Rhumkorff coil; and the light of the spark, emerging from the collimator, is reflected by the small mirror of the Newtonian, and thence to its large mirror. On pushing the collimator-eyepiece and platinum points a little inside the focus, the beam of light will, if every thing is in perfect adjustment, retrace its steps after reflection by the large mirror, and, re-entering the collimator, form an image coincident with the spark; and any want of adjustment is at once betrayed by the image in the field of view of the collimator not being coincident with the spark. Mr. Stoney represented this entire process of completing the adjustment as occupying less than half a minute, and as being so easy of application that he is in the habit of repeating it every time the telescope is turned upon a new object.

— In a lecture, May 23, at the Royal Institution of Great Britain, on recent researches on the distances of the fixed stars, and on some future problems in sidereal astronomy, Dr. David Gill, her Majesty's astronomer at the Cape of Good Hope, summarized as follows the late investigations at that place on the parallax of stars in the southern hemisphere:—

Name of star.	Observer.	Parallax.	Years.
α Centauri	G. & E.	0.75"	4.36
Sirius	G. & E.	0.38	8.6
Lacaille 9352	G.	0.28	11.6
ϵ Indi	G. & E.	0.22	15
α_2 Eridani	G.	0.17	19
ϵ Eridani	E.	0.14	23
ζ Tucanae	E.	0.06	54
Canopus	E.	Insensible.	—
β Centauri	G.	Insensible.	—

The last column contains the star's distance in light-units, or number of years in which light from the star would reach the earth. The observers are Dr. Gill and Dr. Elkin, now of the Yale college observatory, New Haven.

— Oberlin college, in Ohio, has acquired the botanical collection of Dr. Beardslee of Painesville, containing not far from three thousand species. The main part of the collection consists of the phanerogams of northern Ohio; but it also has many plants from the United States generally, especially sedges, grasses, and willows, with over six hundred species of mosses.

— The New-York *Sun* for June 25 gives an instance of ingenuity on the part of some orioles in Central Park, which, finding the twig on which they were building their nest too weak for its support, fastened it by a long string to the branch above.

— Mr. Arthur R. Hunt read a paper to the Linnean society of London, on June 5, on the influence of wave-currents on the fauna inhabiting shallow seas. The author refers to various physical data, among others quoting Professor Stokes and Mr. T. Stevenson; the latter stating that a current of 0.6819 of a mile per hour will carry forwards fine gravel, and that of 1.3638 will roll along pebbles an inch in diameter.

From this and other facts, Mr. Hunt argues that wave-currents do materially influence the marine fauna inhabiting shallow water, not only those of the tidal strand, but likewise those inhabiting the deeper seabottom. He adduces instances of animals living among or on rocks, and of those frequenting sand or other deposits, enumerating species of starfish, mollusks, shrimps, crabs, and fish. He says that even the flat fishes (Pleuronectidae) seem to have changed their original forms and habits for the purpose of being able to live in shallow waters agitated by waves. Referring more particularly to species of *Cardium*, he endeavors to show how, under the influence of wave-currents, the variation of species may be promoted, and even their local extinction brought about.

— Professor Sir William Thomson, of the University of Glasgow, and Prof. E. Frankland, have been elected honorary members of the Academy of sciences, Vienna.

— Professor Ayrton has been formally appointed professor of physics at the Central institution of the City and guilds' institute, London.

— Mr. Carl Pearson has been appointed professor of applied mathematics at the University college, London.

— Professor Edward Hull of the geological survey of Ireland, and his party, sent to Arabia Petraea under the auspices of the Palestine exploration fund, have made a complete traverse of the Wady el Arabah, and constructed a special geological map of this grand valley, as well as a general one of the whole region between the Red Sea and the mountains of Edom and Moab, — the latter on a small scale, thirty miles to the inch, to accompany the personal narrative which is to appear in November next; the former on a larger scale, for the scientific report, which will appear later. The scientific report will be chiefly geological, but will probably contain zoological and botanical chapters by Mr. H. C. Hart, and meteorological data by Mr. Lawrence, together with a beautiful hill-shaded map of the Wady el Arabah, constructed by Major Kitchener and his assistants.

— It is proposed to organize, under the auspices of the American social science association, during its next annual session at Saratoga, Sept. 8-12, an American historical association, consisting of professors, teachers, specialists, and others interested in the advancement of history in this country. Arrangements will be made for the presentation of a few original papers, in abstract, at the first meeting of the American historical association, which will be held in Putnam hall, Saratoga, Tuesday, Sept. 9, at four P.M.

— Before the section of physiology of the international medical congress of Copenhagen will be brought the following problems and communications: Professor Hammarsten of Upsala, the mucous substances, and their relation to the albuminoid substances; Prof. R. Norris of Birmingham, and Professor Hayem of Paris, the rôle of fugitive corpuscles in the formation of fibrine and coagulation, and the relation

between the hematoblasts of Hayem, the *piastriues* of Bizzozero, and the fugitive disks of the blood of Norris; Professor Dogiel of Kazan, the coagulation of fibrine; Dr. Wooldridge of Cambridge, the coagulation of blood; Professor Worm-Müller of Christiania, the proportion of the number of the red globules of blood to the quantity of haemoglobin and to that of the dry globules; Dr. Otto of Christiania, the latest researches on haemoglobin and methemoglobin; Dr. C. Bohr of Copenhagen, researches to determine the absorption in the dissociation of oxyhaemoglobin; Professor Charles of Cork, the gas found in the secretions, especially the bile; Professor Engelmann of Utrecht, Professor Ranvier of Paris, Professor Merkel of Königsberg, and Professor Retzius of Stockholm, demonstrations to show the structure and changes in form of the muscular fibres and of protoplasm in relation to their physiological function; Professor Heidenhain of Breslau, and Dr. Langley of Cambridge, the modifications of the glandular cells during their activity, and the relation between these modifications and the question of the trophic nerves; Dr. Gaskell of Cambridge, the inhibitory or restrictive actions of nervous force, and the restricting nerves in general; Professor Dogiel of Kazan, the causes of the movements of the heart and of their regulation, and of the condition of the hearts of animals which have died from the effects of various poisons; Professor Kronecker of Berlin, the centre of co-ordination of the movements of the auricles of the heart; Prof. H. Munk of Berlin, the functions of the cortex of the cerebral hemispheres; Professor Mosso of Turin, Professor Marey of Paris, and Dr. François-Franck of Paris, the mechanism of the circulation; Dr. François-Franck of Paris, the experimental pathology of the circulation of the blood by artificial lesions of the heart; Professor Burdon Sanderson of London, and Professor Mosso of Turin, the application of instantaneous photography to physiological researches; Professor Marey of Paris, the application of instantaneous photography to the study of voluntary movements; Professor Hensen of Kiel, and Dr. B. Baginsky of Berlin, the relation between the structure and the function of the labyrinth; Dr. Blix of Upsala, the specific functions of the nerves of the skin; Professor Hensen of Kiel, the question whether the doctrine of heredity is to be included in a course in physiology; Professor Kronecker of Berlin, the present state of the knowledge of deglutition; Dr. Openchowski of Dorpat, the automatic, reflex, and inhibitory motions of the cardia of the stomach; and Prof. P. L. Panum of Copenhagen, the slender intestinal fistule for physiological researches.

— Among recent deaths, we note those of Mr. G. H. Boutigny, the physicist, on the 17th of March, at Paris; Dr. T. A. Moesta, on the 9th of April, at Marburg; Dr. J. Bachmann, professor of geology at Berne, at that place early in April; John Williamson of Louisville, Ky., at the White Sulphur Springs, June 16; Prof. J. H. R. Goeppert, who made a special

study of fossil plants, on the 18th of May, at Breslau, in his eighty-fourth year; Don Eulogio Jimenez, a prominent Spanish mathematician, at Madrid; Prof. C. Moesta, formerly director of the observatory at Santiago, Chile, at Dresden, on the 2d of April, at fifty-nine years of age; Professor Schoedler, author of *Buch der natur*, at Mainz, April 27; and Prof. G. von Boguslawski, editor of the *Annalen der hydrographie*, at Berlin, May 4; Henry Watts, the well-known editor of the Watts Dictionary of chemistry, June 30, in his seventieth year.

— The ethnological sub-committee at Berlin has again engaged Capt. J. A. Jacobson for a long expedition through Russia and Siberia, and also through the Amur region to the Pacific coast. Capt. Jacobson, who only a few months ago returned from a two and a half years' journey through Alaska and north-west America, whence he brought a collection of eight thousand objects, will start very soon. After he has made this journey, he intends to go to British Columbia, and enter again the service of the animal-merchant, Carl Hagenbeck, at Hamburg, for whom he has made several journeys before, through Lapland, Greenland, and Labrador.

— The annual meeting of the Entomological club of the American association for the advancement of science will be held in a parlor of Hotel Lafayette, Philadelphia, commencing at two P.M., Wednesday, Sept. 3. In accordance with the rules of the club, the meeting is called the day before the opening of the general meeting of the association. Entomologists who desire to read communications are requested to notify, as early as Aug. 15, either Dr. D. S. Kellicott, president, Buffalo, N.Y., or Mr. O. S. Westcott, secretary, Maywood, Ill.

— To increase the interest in the work of the chemical section of the American association, the chairman of the section, Prof. J. W. Langley of Ann Arbor, has suggested that one or more subjects be brought up for special discussion, and, with the hope that others may be suggested by the members, has issued a circular, in which he puts forward the following as probably offering good opportunity for debate: 1°. To what extent is the hypothesis of valence, or 'atomicity,' of value in explaining chemical reactions? 2°. What is the best initiatory course of work for students entering upon laboratory practice? 3°. What is the best method for determining phosphoric acid? 4°. To what extent is the 'influence of mass' of practical importance in analytical operations? If the choice of a majority of the section falls on one or two topics, Professor Langley will have the titles put upon the Philadelphia announcements.

— As an improvement of the meteorological service on the coast of eastern Asia, a meteorological and astronomical station has been established at Hong-Kong, on the peninsula Kaulun, opposite the city. Hitherto the observatory at Manila warned the port of Hong-Kong when a typhoon approached.